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LATEST ACHIEVEMENTS OF THE ART OF LOCAL, REGIONAL AND SPINAL ANÆSTHESIA.*

BY GASTON L. LABAT, M.D.

OF ROCHESTER, MINN.

SPECIAL LECTURER ON REGIONAL ANÆSTHESIA, THE MAYO FOUNDATION

IN unfolding the literature on local and regional anæsthesia, one is impressed by the slow but steady progress with which these methods have found their way into general surgery. Although they have not been universally adopted as a routine procedure, in many clinics on the Continent they have given a mortal blow to inhalation narcosis during the past few years.

Since the days of the innovation of local and regional anæsthesia by Reclus, Schleich, Selheim, Corning, and Bier, every effort has been strained to improve the results already obtained. Cocain, which was the only local anæsthetic of that time, fell almost completely into disuse when stovain and novocain came to light the same year. These drugs, particularly the latter, gave a new impetus to the methods on which cocain had already cast a heavy shadow.

After passing from the simple intradermal infiltration to the injection of the deeper structures along the line of incision, it could not be expected that local anæsthesia would give any better results than those already obtained by the pioneers, for the simply obvious reason that infiltration along the line of incision would always prove satisfactory when applied to interventions of the very minor types, or when the structures under the direct influence of the cutting instruments could be the site of repeated injections during almost the entire stage of the operative procedure. The "circular anæsthesia" of Hackenbruch was a real progress. It stands midway between local and regional anæsthesia, in that the anæsthetic fluid is distributed around the operative field.

It does not seem that local anæsthesia gradually developed into regional anæsthesia which is based on entirely different principles, but the constant desire for widening the scope of operations capable of being performed without the aid of general anæsthesia suggested the new procedures of nerve blocking by paravertebral and intraspinal injections.

The last decade was very prosperous in many an interesting feature of development. The important contributions of Braun, Läwen, Finisterer, Kappis, Kullenkampf, Härtel, Matas, Crile, Harris, Allen, Pauchet, Sourdat, and a host of others, have converted the method into an art and laid its funda-

* Read before the Chicago Medical Society, May 11, 1921.

mentals on a scientific basis. It is with the refinement of this art that we are chiefly concerned in this paper.

Taking for granted that a thorough knowledge of nerve distribution is required of the surgeon who wishes to, I shall not say succeed in, but attempt nerve blocking, the technic itself exhibits such characteristic features pertaining to a specialty that he finds himself completely hopeless without a fair knowledge also of the principles of the method itself. He has perhaps read hundreds of articles in which indications are set forth, advantages established, and cases reported. He has perhaps watched many operations performed under regional or spinal anæsthesia and has left the operating room greatly impressed with the tremendous work that can be accomplished with a few injections of novocain. Some inquire of the strength and the quantity of solution used, and so forth. But, I am sorry to say, there are very few articles from which the ordinary physician is able to gather the true elements of the art of inducing a good regional or spinal anæsthesia. Most of the literature conveys an impression of anxiety to arouse the enthusiasm of the reader by telling him how much can be done with the method and how safe it is, or, conversely, to discourage by pointing out its dangers and reporting after effects or fatalities. Whatever be the subject under consideration, one should first study the principles of a method and all the circumstances attending its practice before making any attempt to use it. The presence of some anæsthetic fluid in a human body is not always followed by anæsthesia; but its presence in the correct place will never fail to produce the desired result. Let us, therefore, learn how and where to inject it. If some patients are said to be "bad subjects for local," let us study the ways and means of bettering their condition by finding what is wrong with them and by trying to correct it. If the injection is followed by pain or sloughing or produces toxic symptoms, let us see what is the matter with it, carefully observing the symptoms so that we may be able to attribute them either to the anæsthetic fluid or to the adrenalin added to it. We must also beware of the coincidence of some other symptom due to a sudden attack of the disease. Patients suffering from cholecystitis with stones have sometimes exhibited an attack shortly after the injection of morphin, but preceding the anæsthesia. It might have happened during the anæsthetic procedure and might then have been interpreted by the inexperienced as a result of the anæsthetic drug. Let us study briefly the chemistry, pharmacology and physiologic effects of the drugs we propose to inject and learn the ways and means of combating their occasional after effects. In studying carefully the clinical aspect of our patients we shall learn how to distinguish between an after effect and a normal reaction and how to make a judicious use of the various procedures of regional and spinal anæsthesia without apprehension.

I regret that I have not sufficient space to review the general principles of the method of which I have recently published a short review in the ANNALS OF SURGERY; but although restricting myself to only three topics of regional and spinal anæsthesia, I hope they will contain sufficient material to give

you a fair picture of the ploughing of that field in which some of us are now reaping wonderful crops.

The dangers attending spinal injections of cocain for surgical purposes led Cathelin, in 1901, to attempt epidural, caudal or sacral anæsthesia, which was placed on a practical footing by Läwen in 1910. Danis, in 1913, described a method of his own by which the sacral nerves could be reached through the posterior sacral foramina, forming lateral rows on each side of the sacral spinous crest. These procedures may be used separately or combined to constitute what I propose to call " sacral block."

1. When caudal injection alone is resorted to, 30 c.c. of a 2 per cent. solution of novocain containing 10 drops of adrenalin (1 : 1000) should be used in preference to weaker solutions. The anæsthesia sets in less rapidly than in the other forms of nerve blocking, sometimes appearing only after from thirty to forty minutes and resulting only in analgesia which is insufficient for major operations, unless the patient has been strongly narcotized. It is, however, very satisfactory for hemorrhoidectomy, perineorrhaphy, provided the labia majora are not clamped too high, cystoscopy including fulguration, radium treatment of the carcinomatous prostate. For prostatectomy it is not always reliable. Läwen's bicarbonate novocain solution seems to hasten and intensify the anæsthesia and to increase its duration.

2. Transsacral or parasacral anæsthesia is obtained by introducing the needle from the rear through the posterior sacral foramina and injecting from 2 to 10 c.c. of a 1 per cent. solution close to the nerves as they emerge from the sacral canal. The injection is best made with the patient lying on his stomach with a cushion placed under the hips. The anæsthesia appears very rapidly, almost instantaneously, and lasts for from two to three hours; very often there is no postoperative pain when sensibility returns. Its indications are all operations on the anus, perineum, vagina, prostate, bladder, urethra, and penis. When combined with caudal anæsthesia the result is an immediate complete block of all the sacral nerves, and it is considered the method of choice for the Kraske operation.

The foregoing description is but a rough sketch of the picture of caudal, transsacral or sacral block, and can only appeal to those who are already familiar with these procedures and have used them a number of times; but unless a clear detailed description throws more light on the technic we cannot expect the average physician to make them a part of his surgical equipment. Most surgeons have no time to read fifty odd pages selected from *n* chapters with the sole view of gathering the necessary data for one operation. They should be given every chance to acquire, in a few lines, the special technic which they are anxious to use. But they should also understand that unless they have satisfied the requirements of the method, no satisfactory results will be obtained. Nothing, however, can prevent the younger men in the early stages of their career from mastering the general principles of technic, in order to be able to appreciate the current literature on the subject and to use the method with complete success.

The following important points emphasize an adjustment of certain older principles to our modern technic. The preanæsthetic and postanæsthetic care of a patient, as well as the proper outfit for inducing regional and spinal anæsthesia, should have the special attention of the operator. The education of the patient as well as the control of his psychical condition, on which surgeons are still at variance, are the principal factors leading to success. In localities where the method is used extensively, home education is acquired very readily by friends and relatives who have already been operated on by the local method. But in countries where general anæsthesia has been the exclusive method employed, every patient is anxious to go to sleep as soon as an operation is proposed to him. Nurses should learn how to educate such patients as soon as they are sent to the hospital and should tell them all about the method so that they will know what is expected from them during the operation. It is too late to explain anything during the operation; it only helps to arouse suspicion and apprehension at a time when absolute quietude is desirable. The attendant at the patient's head should know how to use his or her judgment in seeking to divert the patient's attention to some other topic or to leave him alone if he feels sleepy and does not protest. The patient should never be told when the operation begins and such questions as "Do you feel that?", "Does that hurt?", "How are you feeling?", and so forth, are strictly forbidden, because they are suggestive and ruinous to the method. If it hurts he will say so. He only needs encouragement when he is anxious or when the length of the operation begins to be a burden or during a very short stage of painful manipulation.

I must emphasize the necessity for the use of narcotics preceding the anæsthesia, but I do not feel inclined to recommend the use of large doses such as would abolish consciousness or impair the general condition of the patient, whose resistance has already been lowered by the disease.

Under the subtitle "preliminary narcotism," Babcock, in 1914, advocated repeated injections of morphin and scopolamin before inducing spinal anæsthesia. A first hypodermic dose of one-sixth grain of morphin sulphate and one one-hundredth grain of scopolamin is given one hour and fifteen minutes before the operation, and a like dose is repeated in cases of robust adults, if in twenty minutes after the first injection they answer questions without evidence of mental confusion. A third dose, Babcock says, may be allowed in certain very robust and resistant patients, of either morphin alone or combined with one-fifteenth grain of apomorphin "if the delirifacient action of scopolamin predominates." These injections are given at intervals of twenty minutes and are used with great caution. I do not know if Babcock still precedes his spinal injections by such massive doses of morphin and scopolamin, but experience confirms the statement that although these combined drugs constitute the most valuable preliminary adjuvant to any form of anæsthesia, they may be reduced without compromising the results of local and regional, and even more of spinal anæsthesia, which is the block anæsthesia *par excellence*. In the majority of cases a single dose of one-sixth

grain of morphin and one three-hundredth grain of scopolamin, given an hour before the anæsthesia, controls the psychic condition of the patient satisfactorily. It is true that narcotics intensify and increase the duration of local, regional, and spinal anæsthesia. They facilitate the administration of general inhalation narcotics to such an extent that very nervous patients are able to take the anæsthetic easily, are maintained and controlled without any trouble with a relatively small quantity of anæsthetic, even during the longest and most traumatizing operations.

At the Clinical Congress for the Study of Local, Spinal and Scopolamin-Morphin Anæsthesia, held under the auspices of the Chicago Medical Society, January 26, 27 and 28, 1915, a most interesting discussion took place which ended in the common accord that scopolamin-morphin when used within the limits of safety so as to bring about a semi-waking condition, has always given gratifying results.

Experience proves that a weak dose of morphin, one-sixth grain, and scopolamin, one three-hundredth grain, used as a routine procedure is ordinarily sufficient to blunt the consciousness of the patient and eliminate to a satisfactory extent the factors of apprehension and discomfort and allow any operation to be performed painlessly, provided the anæsthesia has been induced correctly and every comfort ensured on the operating table. Exception should, however, be made when using the sacral block for the Kraske operation, during which the position of the patient on the operating table creates more discomfort than the operation itself. I am thus in the habit of administering to those patients my routine dose an hour before the anæsthesia and repeating the injection about fifteen minutes before the patient is brought into the operating room. With spinal anæsthesia it has not been found indispensable to use the preliminary narcotic, although the psychic condition of women is greatly benefited by the use of the weak dose. Experience has also shown that narcotics should always be given about one hour before the operation, if any good results are to be expected. The giving of a hypodermic injection of morphin immediately before the patient is sent to the operating room does not help the induction of anæsthesia, whatever the method used. It has been given too late and therefore acts more as an excitant than as a sedative.

Passing on to the anæsthetic drug, I wish to state emphatically that novocain is the anæsthetic of choice both for regional and spinal anæsthesia. It should be pure and freshly prepared. Novocain solutions, contrary to the opinion expressed by almost all writers, lose part of their anæsthetic properties by repeated boilings. Novocain hydrochlorid in powder can be sterilized by autoclaving; its melting point is 153° C. Fresh solutions, prepared by dissolving sterile novocain in cold sterile normal salt solution, are more active.

The addition of adrenalin (1 : 1000 solution) to novocain solutions is now a routine procedure and its action on the blood-pressure is not a novelty; but I wish to call the attention of the medical profession to its use in the future. I was using adrenalin in all my goitre cases (20 drops for each 100 c.c. of

the novocain solution irrespective of the strength of the solution), when I came across Goetsch's adrenalin sensitization test which led him to conclude that it is very near pathognomonic for goiter with exophthalmic symptoms. Contradictory findings have been published, but my clinical experience tends to show that we should be a little more cautious in using the drug. I have reduced the dose to 15 drops for each 100 c.c and do not inject more than 20 drops in the average cases, when more than 100 c.c. of the solution are required. In many instances the poor condition of the heart or the high blood-pressure prompts the use of a still weaker dose. For thyroidectomy I still use 10 drops for each 100 c.c. of the 1 per cent. solution in paravertebral injections, injecting about 50 c.c., that is, 5 drops of adrenalin in all; but if the patient's condition has been diagnosed exophthalmic goitre, I take the safe side and inject pure novocain.

I confess, however, that I had, before taking cognizance of Goetsch's experiments, used adrenalin in all my solutions irrespective of the nature of the disease.

I am thus led to a "*mise au point*" of the alleged danger of blocking the phrenic nerve and the vagus when making paravertebral injections of the cervical nerves. Wieman found that for thyroidectomies, when regional anæsthesia is induced the day before the operation with a view of determining the exact mechanism of the occasional after effects resulting from paravertebral injections, X-rays in a certain number of cases reveal paresis of the diaphragm on the same side, but without any subjective disturbances. The pulse is sometimes slowed, sometimes accelerated, and sometimes unaffected. The most interesting feature of this experiment is the absence of any trouble at the operation the next day, although the anæsthetic is applied on both sides with three or four times as much solution. If the injections are carried down close to the transverse processes laterally, there is very little risk, if any, of blocking the vagus; but it seems to me that the phrenic nerve is anæsthetized in every case although not to such an extent as to paralyze the diaphragm; even then, the intercostal and other respiratory muscles compensate for the functional deficiency of the diaphragm.

During the years 1919 and 1920, some very interesting work has been done on the anæsthesia of the abdominal cavity and its content. The difficulty encountered in handling painlessly the diseased viscus after laparotomy under local anæsthesia of the abdominal wall had already given rise to the paravertebral conduction method in order to obtain a wider anæsthetic field on which the surgical manœuvres would not create too much discomfort to the patient. It was necessary to inject from the fifth dorsal to the second or third lumbar nerves on both sides, that is, twenty to twenty-two nerves (Kappis), or from the seventh to the twelfth dorsal nerves (Labat), that is, twelve nerves. In the latter case, the diffusion of the solution to the adjacent upper and lower nerves probably accounts for the success notwithstanding the difference between the two procedures. Finding this method tedious to the opera-

tor and trying to the patient, a certain number of experiments were conducted with a view to finding a simpler method.

In 1913, Kappis made extensive experiments on dogs with a view to throwing some light on the existing conflict of opinion regarding the sensory distribution of the abdominal cavity and its content. Excluding the use of narcotics he tried to determine what pain it would be possible to induce by irritating the intestines. He divided his experiments into two parts, first, a preliminary, and second, an examining operation. Sections of the cord were made at different heights, sections of the abdominal wall along the costal margin, and the results of his experiments were the following: After sectioning the cord between the fifth dorsal vertebra and the sixth dorsal vertebra there was no pain in the abdomen. After sectioning the cord between the seventh dorsal and eighth dorsal vertebræ, there was no pain in the lower abdomen up to the middle of the small intestine; but the stomach, spleen and upper part of the small intestine were found sensitive. Between the thirteenth dorsal and the first lumbar vertebræ (the dog has thirteen dorsal vertebræ), sensibility stopped at the cæcum. Kappis concluded, therefore, that below the cæcum all organs are supplied by lumbar and sacral nerves. This is confirmed by my clinical experience that the blocking of the three last lumbar nerves and the five sacral nerves gives a complete anæsthesia of the pelvis and its contents.

The sectioning of the splanchnic nerves done by Kappis gives an anæsthesia of the stomach, spleen and upper part of the small intestine. The liver seems to bear an embryologic relationship to the gastro-intestinal tract. The kidney was not deprived of sensibility after sectioning the splanchnics, which proved that at least part of its sensibility originates from the lumbar spine. In 1919, Kappis published another very interesting contribution, which adds to the knowledge obtained from his papers of 1913, that the three first lumbar nerves send rami-communicantes to the retroperitoneal ganglion and therefore take part in the transmission of pain from the upper abdominal organs below the sigmoid colon, whose sensory innervation ends with the third lumbar nerve. The sensory innervation goes through the hypogastric plexus to the rectum and to the urogenital apparatus.

Hoffman's clinical findings, published in 1920 confirm to a certain extent Kappis' experiments, proving that sectioning of the spinal nerves supplying the abdominal wall is not followed by an exclusion of painful impulses which are always present in the mesentery. He also found that the sectioning of the splanchnic nerves abolishes pain, and is of the opinion that these findings can be applied to man. Hoffman goes still further in contending that there is no difference in pain sensation between the cerebrospinal and vegetative nerve systems, which is contrary to the opinion of Lennander, who holds that no sympathetic fibres are able to transmit pain. Hoffman says that both systems have the same centripetal tracts; that they transfer the same conscious sensibility and that they have a unit embryologic history; that the sensory nerves lie in the parietal peritoneum, mesentery, and lesser omentum, and that

these organs are the starting point of abdominal pain. He made sections of the peritoneum and used the method of Bielschowski modified by Schultz and Gross, in which nerves are tinted black and easily seen. Vessels are sometimes stained by this procedure, but good pictures of nerve ramifications are usually obtained by which it is easy to distinguish the nerves from the blood-vessels. Sensory nerve fibres were found to accompany the vessels of the mesentery and also those of the parietal and visceral peritoneum. Certain regions between two vessels contained no nerves. Clamping two adjacent vessels of the mesentery produced pain, and in treating this region by the above process it was found that the clamped vessels contained nerves coming from the splanchnic or sympathetic chain. Dissections also showed that the splanchnic nerves had fibres running to these clamps.

Kappis does not deny the presence of nerve plexuses supplying the viscera and containing sensory nerve fibres, especially pain-conducting fibres. Their number is relatively small as compared to the extent of the viscera supplied and for this reason they lose their ability to transmit painful impulses in the proximate vicinity of the organ itself. It may be that these fibres do not reach the organ with the other nerves but end at a certain distance from it; it may also be that they do not reach the organ in such number and size as to permit of impulses being interpreted as pain. Clinically, abdominal organs are insensitive.

Consequent upon the above findings it was thought rational to try the anæsthesia of the splanchnic nerves and that of the rami-communicantes given off by the first three lumbar nerves. A posterior route of approach was studied on the cadaver and applied to the patient, which has given, in the hands of Kappis, Naegeli, Hoffman, and myself, satisfactory results, especially in very lean patients. The solution diffuses sufficiently in the retro-peritoneal tissue to secure at the same time the anæsthesia of the cerebrospinal nerve plexuses lining the posterior wall of the abdominal cavity under the direct influence of the operative manœuvres. The technic is simple and safe and should be tried as often as possible in abdominal surgery.

I should like to approach the question of spinal anæsthesia, not with the view of discussing the methods already employed on the Continent and in America, but of presenting a technic I have been using for the last three years without any untoward effects, and I may say no failures. The practice of dissolving the anæsthetic drug in cerebrospinal fluid for the purpose of intraspinal injection is not new, but the many little details attending the injection of such a solution are those to which I wish to call your attention, since my impression is that the absence of one or more of them is likely to bring about troubles ranging from the simple headache to the occasional cessation of respiration. Briefly, my technic is as follows:

The patient is injected in the upright position as usual. The puncture is made at any level between the twelfth dorsal and the fifth lumbar vertebræ, according to the height of the anæsthesia desired. No attempt is made to produce anæsthesia higher than the line of the nipples. After making the

puncture, the first few drops of cerebrospinal fluid are allowed to flow out, so as to obtain a clear fluid which is allowed to fall in a special ampule containing the anæsthetic drug. More fluid is withdrawn, varying between 10 c.c. and 25 c.c., according to the condition of the intraspinal pressure which very often agrees with the blood-pressure. The appearance of headache should prompt the cessation of further withdrawal of fluid. The solution thus made is aspirated ito any kind of syringe by means of a spare needle, the syringe is then adapted to the spinal puncture needle and as much new fluid is brought into the syringe as it now contains solution. Half of this is injected very slowly, more new fluid is aspirated, the syringe is discharged in the same way, leaving less and less fluid in it, and at the end of four or five injections it is emptied. There is no hurry in placing the patient in the recumbent position, but there is also no reason for keeping him in the erect position. He is, therefore, placed on his back, and, by the time the operative field is prepared, he can be placed in the Trendelenburg position and stay there until sensibility returns without prejudice to his respiratory function. As is usual with spinal anæsthesia the blood-pressure falls in the majority of cases very rapidly, affecting only the maxima, and comes back to normal later, sometimes during the operation and sometimes only in the afternoon, without changing the clinical aspect of the patient whose condition he, himself, considers to be very satisfactory. The minima is but little affected. No postanæsthetic headache, nausea or vomiting has been observed following 110 * spinal anæsthesia given in the Mayo Clinic since my arrival October 2, 1920. A nauseated condition sometimes exists, especially with the Trendelenburg position, which disappears rapidly by deep breathing. No special postanæsthetic care nor position was especially indicated in the patients thus anæsthetized.

I am familiar with Barker's and Babcock's solutions and technic. After using stovain, cocain and a combination of cocain and novocain, in varying doses, I have adopted novocain in doses of 0.10 gm. and 0.12 gm., according to the body weight of the patient. One centigram for each fifteen pounds of body weight has clinically proved to be a safe dose and produces satisfactory anæsthesia for a period varying from one hour to one hour and a half. No adrenalin is added to the novocain which should be chemically pure and sterile. Adrenalin is here of no use, since its action on the blood-vessels is of no avail in the spine.

The necessity for making the injection as slowly as possible is to keep the solution in the close vicinity of the site of puncture and allow the nerve structures to take up the greater part of the anæsthetic, leaving a dose too weak to produce anæsthesia by diffusion higher up. The anæsthetic fluid acting as a dye impregnates the nerve tissues more deeply at its first point of contact.

After withdrawing a certain quantity of cerebrospinal fluid the intraspinal pressure decreases while the secretion and excretion of more fluid has to take

* The number has since greatly increased.

place in order to make up for the deficiency created by the withdrawal of such fluid, so that if the intraspinal injection is made very slowly there is no reason why the injected solution should ascend toward the head. The normal circulation of cerebrospinal fluid also helps the injected solution to flow toward the blood circulation, that is, toward the periphery. I do not consider the cessation of respiration which might happen in such cases to be due to the direct action of the anæsthetic fluid on the respiratory centres by diffusion up the spinal canal; but its passage in the general circulation is probably the cause of such trouble when too heavy a dose has been administered. Without exerting great pressure while making the injection, the anæsthetic fluid does not ascend toward the head when using cerebrospinal fluid as the solvent of the novocain. Patients placed in the Trendelenburg position for one hour do not show anæsthesia of the upper extremities, thus indicating that no solution, at least no active solution, reached the emergence of the roots constituting the brachial plexus. The spine cannot be considered as a test tube and all experiments *in vitro* cannot be applied to the human spine unless rough handling of the technic disturbs the physiology of its contents. The disturbance of the contents of the subarachnoid space may be compared to that of a vessel containing water, whether still or circulating, when a stone is thrown into it (the injection representing the stone), ripples will be formed which represent the injection waves; the heavier the stone, the greater the disturbance and the larger the ripples, the greater the pressure with which the injection is made, the greater also is the intraspinal disturbance and likewise the injection waves, which then might reach the head.

Le Filliâtre was the first to induce general anæsthesia by means of spinal injections made as low as between the fifth lumbar vertebra and the sacrum. His technic is based on the fact that great pressure is capable of running the solution up toward the head, thus producing general anæsthesia.

The conclusion must be reached that pure sterile novocain, dissolved in cerebrospinal fluid in doses of 0.01 gm. for each fifteen pounds of body weight of the patient, is a safe procedure, provided the injection is made very slowly.

I have not seen any contra-indication to spinal anæsthesia with the technic I use, unless it is in patients whose blood-pressure is below 100. Even then, if the condition of the patient does not allow him to have any other form of anæsthesia, I would not hesitate to use spinal anæsthesia, injecting, at the same time subcutaneously, spartein sulphate, one grain, caffein, four grains, and strychnin sulphate, one-sixtieth grain, repeating the dose, if necessary. Patients suffering from fibrillation of the auricles have behaved themselves very well under spinal anæsthesia when operated on for diseased gall-bladder or prostate.

CONCLUSIONS

Regional anæsthesia, in which should be included spinal anæsthesia, has developed into a science and should be treated as such. To be successful the anæsthetist should have a perfect knowledge of anatomy and surgical technic,

and should be familiar with the chemistry, pharmacology and the physiologic effects of the drugs he administers. He should know how to handle the patient before and during the operation and, above all, have mastered the general principles of the methods.

The surgeon who operates under regional anæsthesia should be familiar with the general principles of the method so as to be able to complete the anæsthesia during the operation. He should not have recourse to general anæsthesia when one or two injections, judiciously made, would render the operation painless. Such knowledge would also give him a correct idea of the extent of the anæsthetic field and in a general way help him to understand the after-effects, if any, and the treatment thereof.

The beginner should not be expected to be successful with his first attempts; partial failures can be remedied by inhalation narcotics. He should not abandon the method as being worthless or insufficient. He should remember that even experts may fail and should try it again, observing scrupulously its principles until he succeeds. There is no reason why he should not succeed when in the hands of others the results have been so satisfactory. But he can readily understand from the foregoing how necessary it is to have an exact knowledge of the technic and attending circumstances of spinal anæsthesia if he wishes successfully to employ such a delicate procedure.

Novocain is the anæsthetic drug of choice in both regional and spinal anæsthetic procedures. It should be pure, and when injected intraspinally, pure and sterile and dissolved in the cerebrospinal fluid of the patient. The dose of 0.01 gm. of novocain for each fifteen pounds of the body weight of the patient, injected very slowly, is safe for any operation below the diaphragm.

May I at the end of this paper suggest that every young medical student should devote part of his time to studying this method so as to be able to apply it later on in his own private practice? And since a knowledge of general surgery is required, he who is anxious to make it a specialty should have a post-graduate course in that subject.

THE MALIGNANT DEGENERATION OF BENIGN TUMORS OF THE THYROID GLAND*

By John Speese, M.D.
and
Henry P. Brown, Jr., M.D.
of Philadelphia

It is admitted generally that cancer of the thyroid gland, as cancer elsewhere, has a tendency to develop in those glands which have been the seat of preëxisting disease, *i.e.*, goitre. In order to determine the relative degree of malignant degeneration found in the various benign lesions of the thyroid, we have examined the material obtained in the Surgical Laboratory with this idea in view, attention being directed to the association of cancer with colloid goiter, colloid and fœtal adenomata, and papillary cystadenoma.

Although cancer of the thyroid has been regarded as a rather rare affection by many writers, this view has not been corroborated by many recent contributions to the subject. Among the older reports mention may be made of the statistics of Limacher [1] in Berne, who found forty-four sarcomas and thirty-eight carcinomas in 7641 autopsies; Chiari in Prague, fifty-five sarcomas and eleven carcinomas in 7700 post-mortems; giving reason for the assumption that malignancy was not only rare but had a tendency to occur largely in goitrous regions. Balfour,[2] on the other hand, recently records 103 cases of cancer in 6359 cases of goitre, exclusive of the exophthalmic group, a percentage of 1.6 per cent. These cases occurring in a distinctly goitrous region (Minnesota) are to be contrasted with a decidedly higher percentage of 4.6 per cent. found in our own cases developing in Pennsylvania, where goitre is decidedly uncommon. Porter reports a cancer incidence of 3.64 per cent., but adds that considering the percentage of cures (100) one is led to question the diagnosis in some, at least, of his cases.

Although Bloodgood [3] noted a high percentage of malignancy, nine cancers and one sarcoma in 148 thyroid lesions, the association of previous goitre was not observed, and there was a history of goitre earlier in life in one case only. Taking into consideration the slow growth in some cases of thyroid cancer, Chambers [14] thinks it probable that in many instances the condition is rather one of a continuous slow development of a malignant goitre, rather than a malignant one superimposed on a benign growth.

The majority of writers, however, lay much stress upon the etiologic significance of benign growths in the development of cancer. Balfour [2] states that such an association is almost invariable, Delore [4] in 82 per cent. of the cases, Müller and Speese [5], 59 per cent., while Kocher,[6] Langhans,[7] Lucke [8] and Carrel-Billard [9] all emphasize the common association of benign and

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malignant struma. That preëxisting goitre is a factor in the development of sarcoma is noted in Lartigau's [10] analysis of fifty-one cases in which there was a history of goitre in thirty-five instances.

In many reports in which the history of benign goitre has not been elicited, it is probable that it was not noted because a careful examination was not made, or the patient had paid little or no attention to an enlargement common and of little significance, particularly in goitrous regions.

While the disease is considered more prevalent in goitrous districts, Berry [11] states that even in cases in which there is no history of preëxisting goiter it will be found often, upon examination after removal, that the tumor contains cysts, points of calcification, or some similar evidence of former disease.

Ehrhardt [12] believes the inflammation, calcification, cystic formation, hemorrhage and necrosis found in old goitres, whether clinically apparent or not, tend to act as chronic irritants. In such degenerated areas the epithelium is frequently so atypical that a diagnosis between a benign growth and early malignancy is often very difficult, and he further believes that in this atypical development lies the relation of previous disease of the thyroid to malignancy. Other etiologic factors to be considered are previous inflammation of the gland (de Quervain [13]), trauma (Cornil), and in two cases Kaufmann found cancer to be closely associated with pregnancy.

The material examined comprises 426 lesions of the thyroid gland, in which cancer occurred nineteen times and sarcoma three times. In addition six other cancer cases from outside sources have been studied in the laboratory, making a total of twenty-eight malignant thyroid tumors.

Reviewing the clinical history of these cases, the gross and microscopic examination, cancer was found associated with the following diseases: Colloid adenoma, ten; fœtal adenoma, four; papillary cystadenoma, three; colloid goiter, four; colloid goitre and sarcoma, one.

In five cases a history of goitre preceding the development of cancer could not be elicited and evidence of previous disease could not be found in the pathological examination. In one of the three sarcomata, a preexisting colloid goiter with marked fibrosis acted as the predisposing factor.

The study shows, therefore, that in twenty-eight cases of malignancy (twenty-five carcinoma, three sarcoma) a preëxisting goitre was present in twenty-two instances, a percentage of 78.5 per cent. In two cases only were secondary operations performed. We were unable to ascertain the nature of the tissue removed, as both were done in hospitals some distance away. From the history, partial thyroidectomy presumably was performed. The question naturally arises, in these cases, as to whether a small adenomatous nodule being left behind may have been stimulated by the traumatism of the operation to undergo malignant degeneration, and such instances naturally suggest the thorough exploration of both lobes of the thyroid for such adenomatous nodules, and of course, their thorough extirpation.

In the following table is shown the duration of the primary tumor before

the appearance of symptoms indicating malignant degeneration. The average time of twelve and six-tenths years clearly demonstrates that early operation for removal of the benign lesion would have prevented the development of cancer in the majority of cases: three months, one case; three years, one case; six years, two cases; ten years, three cases; thirteen years, one case; fifteen years, six cases; eighteen years, one case; twenty years, one case.

Further study of the cases shows that symptoms indicating toxic manifestations were present in five. These symptoms, in one instance only, were of a severe nature, the majority of the patients complaining of tremor, tachycardia and loss of weight.

Change in the physical characteristics of the primary benign goitre was the chief symptom, fourteen of the patients stating that enlargement and increase in consistency of the growth were the first symptoms noted. Pain of a neuralgic and radiating type was first noted in five instances; dyspnœa in five, dysphagia in two, hoarseness and cough in one each.

The diagnosis of thyroid cancer in the early stages is difficult or impossible; the majority of our cases were only discovered after operation or in the course of the pathologic examination of the specimen. This corresponds to Balfour's experience, in which 18 per cent. of the cases only were positively diagnosed clinically as cancer, and in 46 per cent. the condition was not even suspected or was only discovered after operation.

The number of cures would naturally be greatest in the cases discovered after operation, and the eight cases of which we have record of no recurrence are all in this class, and represent, of course, malignancy in an early stage, and therefore a curable one. The percentage of cures in this group is fairly high and the fact that there has been no recurrence in a large percentage of the cases in various clinics, indicates that complete extirpation of the thyroid is not necessary when malignancy is found in an adenomatous nodule, providing there has been no extension beyond the capsule of the gland.

In Balfour's statistics the operative mortality was 6 per cent.; 47.6 per cent. died within a short time of recurrence, 11 per cent. have recurred, 35 per cent. have had no recurrence, many of these being of short duration. The operative mortality and permanent results have been much improved since 1897, when Carrel-Billard quotes in 110 observations an operative mortality of 53.6 per cent. (13.6 per cent. immediate, 40 per cent. within a few days), and 10 per cent. of cures.

In discussing the etiology of the adenocarcinomata, Kocher [6] states that the tumor begins in a circumscribed area, pushing the healthy gland to one side. Whether this area is the starting point of the cancer, or whether its origin is to be sought in the growth of embryonal cells or in small nodules of degenerated adenomatous tissue, is difficult to determine clinically. The cancer rarely involves the entire gland, usually one lobe only, and the isthmus in very exceptional cases. The growth may develop in accessory thyroid

tissue and the main gland remain free. Langhans believes that the growth originates in fœtal cells, which, remaining latent for many years, under some form of irritation take on active growth and develop. The factors which are active in the production of simple goitre may be the ones which call forth the active and later malignant degeneration of these embryonal cells, which have a greater tendency to grow in parts already the seat of pathological changes.

It is significant that Balfour mentions seven cases in which malignancy occurred in an enlarged thyroid that had been treated previously by injections of various irritants and by the application of absorbents, convincing examples of the fact that chronic irritation is the chief factor in inducing malignant changes and should serve as an argument against dangerous methods of treatment.

The study of hyperplasia and carcinoma of the thyroid in the salmonoid fishes by Gaylord,[15] on account of the great similarity in the changes in the organ of the fish to those occurring in mammals, seems likely to throw important light upon the origin of certain structures which have been the subject of extensive study in the thyroid of mammals.

According to Michaud, adenomatous tumors are formed by proliferation of the normal structures of the thyroid. The description given for the development of such adenomata in the mammalian thyroid is exactly like the beginning changes leading to carcinoma of the thyroid in fishes, and it is evident from this study that the changes in the thyroid are brought about by the action of some agent working focally upon the epithelium of normal vesicles, and thus we can clearly exclude all possibility of embryonic rests playing a part in the genesis of circumscribed adenomata or cancer.

Endemic goiter and carcinoma of the thyroid in the Salmonidæ are to be regarded as one and the same thing. Viewed in the light of modern cancer research, it appears to Gaylord that the term carcinoma is in every respect the most suitable. The first positive results obtained in dogs and rats must for the present be classed as diffused parenchymatous struma. Adenomata have been produced in rats, and, as it is well known that such adenomata of the thyroid develop in what is called cancer of the thyroid, it appears quite possible that further experiments may show that in mammals experimental parenchymatous and nodular struma are but the early stages of the process which is called cancer of the thyroid.

Cancer of the thyroid may manifest itself as a primary tumor by changes in the physical characteristics of an old goitre, or by symptoms due to involvement of adjacent structures, *i.e.*, œsophagus, trachea, etc. In rare instances, according to Carrel-Billard, initial symptoms of altered thyroid function precede local manifestations by several weeks or months.

As a rule rapid increase in size of a goitre previously quiescent is the first and most common symptom of malignancy.

The growth becomes irregular and there is a decided increase in its

consistency. These symptoms are regarded as so important by Bloodgood [3] that he urges immediate operation in every asymmetrical enlargement of the thyroid in individuals over thirty years of age, for only by following this rule will surgeons eradicate malignant tumors before they have produced inoperable metastases.

Carrel-Billard described three types of thyroid enlargement due to cancer: The acute variety, in which sudden increase in size is followed by rapid invasion of the surrounding parts, is usually fatal within a few weeks. The cases occur in comparatively young people and there may be no history of preëxisting tumor.

Cancer in a non-goitrous thyroid is very rare. The patient usually discovers a small movable tumor, which may appear in any part of the gland. The growth, at first slow, with no alarming symptoms, suddenly becomes active, infiltrating the thyroid and surrounding parts, with the characteristic symptoms of malignancy. The acute enlargement in young people, at a time when physiologic activity of the gland subjects it to sudden changes, is not so serious as in the old. Enlargements, therefore, in those over thirty or forty should be regarded as a suspicious symptom. Unfortunately the appearance of a nodule is not always demonstrable, and the cancer may be represented by a small growth embedded in and surrounded by normal thyroid tissue, there being no appreciable increase in size of the gland. This type called the "latent form" is very insidious in its course, and there is nothing to show that the thyroid has undergone malignant degeneration until visceral or osseous metastases appear. In some instances the development of the cancer is preceded by severe neuralgic pains, which radiate to the head, neck, or arms, and aid is sought for the neuralgia or hoarseness without a tumor having been noted by the patient.

In the more common instances in which cancer develops in thyroids the seat of goitre, a subacute course is followed. The period between the primary enlargement of the goitre and before extracapsular extension of the cancer, the period when operation should be performed because metastasis or infiltration has not occurred, is difficult to estimate. In Carrel-Billard's cases from two to six months elapsed from the initial enlargement until surgical aid was sought, and Kocher states that, as a rule, within three to nine months malignant tumors extend beyond the thyroid capsule.

Either before or after the appearance of a malignant tumor, the patient may complain of symptoms analogous to those of toxic goitre. In numerous cases, tachycardia, tremor, palpitation and certain metabolic disorders may be present without a definite tumor, this may appear later and take on the definite changes of malignancy. The development of cancer, according to Carrel-Billard, alters the thyroid secretion, so that increase or decrease of thyroid function may appear under variable conditions. The intoxication of cancer manifests itself in different ways and varies in its nature and intensity. From mildly toxic symptoms, various grades are met with up to acute intoxication with fatal cachexia developing within a few weeks or months.

In Carrel-Billard's series of eighty-three cases, twenty-six patients gave a more or less clear picture of toxic manifestations; the same symptoms were noted five times in our cases. The reaction of the organism to the toxæmia of thyroid cancer is classed under three heads: (1) Hyperæmia, (2) Symptoms of Basedow's Disease, (3) Disturbance in Nutrition.

1. A rise in temperature 38–38.5° to 39° C. may precede the appearance of the tumor. The patient becomes cachectic, and only after the lapse of some weeks is the cause (cancer) demonstrable. Fever, more constantly found in sarcoma than in carcinoma, is regarded as a symptom of altered thyroid function.

2. Symptoms of exophthalmic goitre, not always characteristic, have been discussed above.

3. Disturbances in nutrition are manifested at first by loss in weight, a definite cause of which is not always apparent. Urinary disturbances, increase or decrease, are frequently encountered.

Sarcoma likewise may produce toxic symptoms as was noted by Tillaux,[16] in which typical symptoms of exophthalmic goitre, except tachycardia, were noted. Following extirpation of the sarcoma, the toxic symptoms disappeared; the patient died later of lung metastasis.

While hypersecretion of the thyroid is thus seen to be fairly common in cancer, the absence or lack of secretion is exceedingly rare, for there is usually sufficient normal thyroid tissue to carry on the function of the gland. It should be pointed out that whereas the development of cancer may be attended by alteration of thyroid secretion and the production of toxæmia, so far as we have been able to ascertain, a true exophthalmic goitre has never been known to undergo carcinomatous degeneration.

CONCLUSIONS

1. Benign tumors of the thyroid gland preceded the development of malignancy in practically all cases.

2. Cancer is found more frequently associated with colloid and fœtal adenomata, and is relatively uncommon in simple colloid goiter.

3. Thorough exploration of both lobes of the thyroid is indicated to prevent leaving behind a small adenomatous nodule from which malignancy may develop at a later date.

4. When cancer is present clinically and diagnosis easy operative measures offer but little hope. The majority of cases are discovered in the course of operation or in pathologic examination. The greater number of such cases are cured by operation (70 per cent.).

5. Early operation in all goitres is indicated to prevent malignant degeneration, which on an average in our cases has occurred twelve and six-tenths years after the appearance of the benign goitre.

6. Toxic symptoms occasionally occur in cancer, may precede the appearance of the malignant tumor and obscure the diagnosis.

7. Enlargement of a preëxisting goitre and increase in its consistency are the first symptoms of carcinomatous degeneration of a benign struma.

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TRAUMATIC CHYLOTHORAX*

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I feel justified in presenting this case not only because of its extreme rarity but because I believe my experience may prove of value to others.

Case Report.—R. A., white male, aged thirty-five years, entered the University of Virginia Hospital January 4, 1919.

Family History.—Unimportant. Previous History.—Unimportant. Present Illness.—He was admitted to the Western State Hospital for the Insane on December 20, 1918. The next morning at breakfast he secreted a dull case knife and was found half an hour later with his throat cut. He had shoved the knife into the suprasternal notch as far as he could, moved it crosswise and up and down, said he put it in three different times. When Doctor DeJarnette, to whom I am indebted for this history, reached him he was lying on the bed with blood running from the wound and into the lungs, the trachea apparently being cut. His head was lowered and the blood soon began to run out of his lungs. This helped his breathing very much and the bleeding soon ceased. He was given a cup of water, which he drank with comfort, and the œsophagus was thought to be uninjured. He was given a diet of milk and eggs and was thought to be doing nicely until December 23rd, when he began to strain and cough and tried to vomit, expelling a good deal of "milk" (chyle) from the wound in his neck. On December 28th, the left pleural cavity was aspirated at the angle of the scapula and three quarts of "milk and eggs" removed. The fluid had no bad odor and was not curdled at all. Before aspiration the slightest movement would exhaust him and he could scarcely breathe, panting like a dog in the summer time. Two days later the right pleural cavity was aspirated and thirty ounces of fluid, similar to that described above, was removed. It was thought that his œsophagus had been cut and that his diet of milk and eggs had been running into the pleural cavities instead of into his stomach. An X-ray examination was made of the œsophagus, after inserting a tube filled with barium sulphate, and the tube seemed to enter the stomach, but in spite of this it was decided not to feed him for three days hoping the wound in the œsophagus might heal. He was given saline and nutrient enemata and allowed to wash his mouth frequently with water, but was not permitted to swallow anything for three days. At the end of that time it was noticed that his left pleural cavity had filled up again and it was found that he had been drinking water. He admitted that he had drunk three pints, but he was aspirated on January 2, 1919, and one gallon withdrawn. This fluid was highly tinged with milk, probably from the residue left after former aspirations. There was no further effusion in the right pleura after the first tapping. On January 4, 1919, the left pleural cavity was again aspirated, removing five pints of "milk and eggs", which was thought to have been put in the stomach through the tube. This improved his breathing but he complained considerably of hunger and thirst. He was brought to the University of Virginia Hospital the same day, *i.e.* fourteen days after the injury, and the following note was made: Patient is a large man and says that before injury he weighed 170 lbs., but he has evidently lost a great deal of weight and apparently now weighs not over

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140 lbs. He answers questions rationally and is not at all wild, seems anxious to get well. His temperature is 98, pulse is of fair quality, 80 to the minute. In the interclavicular notch just above the sternum and slightly to the left of the mid line there is an incised wound 1.5 cm. long which looks fairly clean, there being only a slight purulent discharge from it. There is no evidence of the escape of air or food from the wound. The right side of the chest is resonant throughout on percussion, and auscultation shows only a few râles at the base. The left chest was aspirated four or five hours before patient came to the hospital and examination of this side of chest now shows evidence of only a small amount of fluid being present. The doctors who brought him to the hospital seemed so sure that his œsophagus had been cut and food was running into his chest, and being unacquainted with traumatic chylothorax myself, it was thought best not to wait for further examination, so a frank gastrostomy was immediately done under local anæsthesia. I suppose we should have reasoned that had food been leaking into the chest signs of inflammation would be present after this length of time.

After the operation the patient was given nothing by mouth, but fed through the gastrostomy, and for several days seemed to be doing fairly well. Three days after operation the left chest was aspirated and about two quarts of yellowish milky fluid removed. Cultures were taken from the fluid and a careful analysis made which proved it to be chyle. The analysis, as made by Dr. W. E. Bray, is as follows: Cream colored, milky fluid; alkaline to litmus; specific gravity 1018; clot formation none; almost clears when made alkaline and shaken with ether; fat five per cent.; protein one and two-tenths per cent.; globulin a trace; sugar present. Microscopic examination: Smear shows about thirty-six per cent. of white cells, the polymorphonuclear leucocytes predominate, but many lymphocytes are present. A few cocci are seen. Diagnosis: Chylous exudate with a relatively slight inflammatory exudate.

It was intended to feed the patient by injecting this fluid, removed from the chest, into a vein, but this idea was abandoned when a coccus was grown in the culture.

The patient now began to go down hill rapidly. He became rather irrational restless, tried to get out of bed. He coughed a good deal and spat up some brownish sputum. His pulse became weaker and more rapid and for several days before death he had a slight evening temperature, 100.5 to 101. The left chest was aspirated again the day before he died and one quart of fluid removed. Death occurred on January 10, 1919, twenty days after the injury was received.

Autopsy.—Performed by Dr. E. R. Hipp, to whom I am indebted for his very careful dissection. Body is very much emaciated. Incised wound (somewhat necrotic about its edges) in interclavicular notch, from which white fluid can be expressed. Examination, following out this wound, shows the knife to have gone down beside the trachea, injuring none of the great vessels at the root of the neck but nicking the trachea and glancing off to the apex of the left pleural cavity, which was opened. The thoracic duct was dissected out very carefully and found to be almost severed near the opening in the left pleural cavity mentioned above. The œsophagus was not injured as shown by inflation. The thoracic duct was removed en bloc with trachea, œsophagus, vessels of root of neck and several lymph glands for museum specimen (Fig. 1). Chest: Left chest was filled with milky fluid containing lumps of coagulum. Left lung was adherent to diaphragm and chest wall by both old and fresh adhesions. The surface of this lung was covered with white coagulum and the old pleural tags mentioned above, and on section presented the picture of chronic passive congestion. The right lung was bound down by a few old adhesions at the apex, otherwise examination of the right chest and lung was negative. Abdomen:

Gastrostomy wound clean. The peritoneum was smooth and glistening and no free fluid was present. The subperitoneal fat was limited. Examination of abdominal organs negative.

Milky effusions in the serous cavities are quite uncommon. They occur most frequently in the peritoneum, are less frequent in the pleura and are very rare in the pericardium; the peritoneum seems to be involved about twice as often as the pleura. These milky pleural effusions are of two varieties: (1) The true chylous, in which chyle escapes into the pleural cavity as a result of some lesion of the thoracic duct, and (2) the chyolid (pseudochylous), due to pleuritic effusion, simple or tuberculous, abscess of the lung, carcinoma of the pleura, lymph-vessels and lymph-glands, extreme cardiovascular changes, and a few other conditions.

True chylous exudates show all the properties of chyle. The fluid is white and milky, sometimes reddish, due to the presence of blood. It tends to accumulate rapidly, resists putrefaction, does not coagulate on standing, contains fine fat globules which may be readily stained with osmic acid or Sudan III, and clears on alkalinizing and shaking with ether. The specific gravity generally exceeds 1012. The fat content is usually high, varying from one-half to four per cent. In most cases it presents a definite sugar reaction. Lecithin appears only in traces.

The chyloid effusion accumulates less rapidly, is less milky, contains much less fat, sometimes only a trace, and is not so completely cleared on shaking with ether. The cellular elements may be numerous and often contain fat. The specific gravity is usually less than 1012. It contains serum albumin and a complex of lecithin and globulin to which its opacity is attributed. Traces of sugar are found.

Lewin [6] in 1916 was able to find only fifty-one cases of true chylothorax since the time of Bartolet, who (quoted by Rotmann [7]) is said to have described the first case in 1633. In 1918 Funk [8] added three cases, including one of his own, and I have been able to find three other cases besides my case described above, which makes a total of fifty-eight cases reported up to the present time.

Before discussing the etiology of true chylothorax it might be well to recall the anatomy of the lymphatic vessels as they pass through the thorax, which is well described by Funk in his excellent paper, "The lymph coming from all parts of the body is collected into two tubes—the right lymphatic duct and the thoracic duct. The right lymphatic duct is smaller and collects the lymph from the right side of the head and neck, right arm, right side of chest, and the upper convex surface of the liver. This duct empties into the venous system at the junction of the right internal jugular and subclavian veins. Of greater importance, because it conveys chyle in addition to a great mass of lymph into the blood, is the left lymphatic duct or thoracic duct. It originates in the abdomen at the receptaculum chyli at the level of the second lumbar vertebra and enters the thorax through the aortic opening of the diaphragm to the right of the aorta and traverses the posterior mediasti-

num between the aorta and the vena azygos major. As it ascends it lies on the bodies of the seven lower thoracic vertebræ with the pericardium, œsophagus, and the arch of the aorta in front. At the level of the fifth thoracic vertebra it inclines toward the left side, ascends behind the arch of the aorta on the left of the œsophagus, and behind the first portion of the subclavian artery. At the level of the seventh cervical vertebra it turns outward and then downward over the left pleura, subclavian artery and scalenus anticus, and empties into the venous system at the junction of the left internal jugular and subclavian veins." Although it has been proved anatomically in only a few instances, it is thought by many that the thoracic duct may anastomose with the right lymphatic duct and the azygos veins. This seems to be borne out by clinical experience, namely the absence of ill effect when the duct is ligated during operations in the neck, and Warschauer [8] has even suggested the advisability of intentional ligation of the duct in all operations in the neck in which it might be endangered. It seems to me that the absence of chylothorax following ligation of the duct in the neck and its occurrence in certain pathological lesions of the duct might be explained on the ground that in the latter conditions the collaterals are often involved.

Injuries of the thoracic duct in the neck occurring during operations in this region have been thoroughly discussed in recent years by Zesas [9] and by Harrison.[5]

In 1908, F. A. Baldwin [1] collected forty-seven cases of true chylothorax of which thirty-one were males and ten females and whose ages varied from two to sixty years. The etiology of these cases was given as follows: Traumatic, sixteen; pressure upon the duct by new growths or tuberculous lymph-nodes, nine; secondary growths in duct, nine; thrombosis of left subclavian vein, four; proliferating lymphangitis, two; aneurismal dilatation of duct, two; thrombosis of duct, one; result of removal of carcinomatous glands of neck, one; obstruction of radicles of duct from inflammatory thickening of mesentery, one; mitral disease, one; filariasis, one. Of this series 34 per cent. were traumatic in origin.

In 1912, Zesas [10] collected twenty-four cases of non-operative injury of the thoracic duct, including wounds of the duct in the neck. The injuries of the duct were thus produced: Four times by gunshot; twice by a cut or stab; six times by fracture of ribs or collar-bone; once by vertebral fracture; three times by fracture of the ribs and vertebræ; seven times by "coutre-coup." In seventeen of these cases chylothorax was present, in one chylo-ascites. The chylothorax was on the right side in ten cases, on the left side in four cases and bilateral in three cases.

The more frequent occurrence of chylothorax on the right side is quite natural considering the anatomical relations of the duct and the right pleura; the right pleura is closely approximated to the duct and forces which affect the duct are apt to injure both structures at the same time. Some authors, notably Hammesfahr, think that as a result of the negative pressure in the

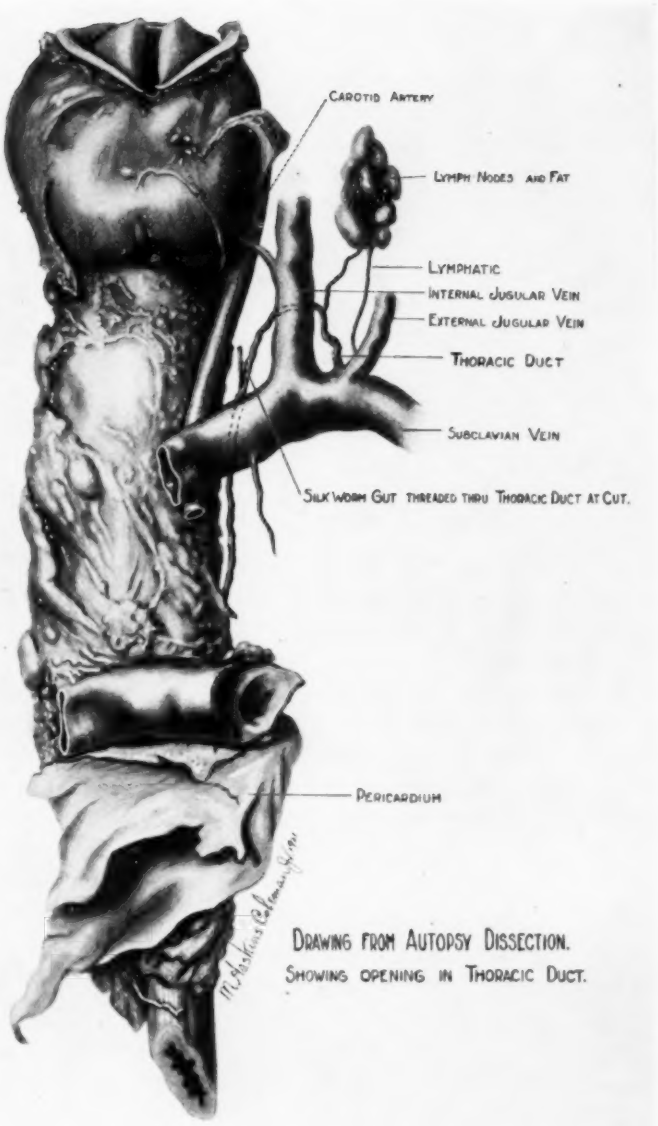

FIG. 1.—Autopsy dissection showing opening in the thoracic duct.

chest chyle can escape into the pleura from the mediastinum through the normal intercellular spaces between the endothelial cells. It seems to me that this is the only way in which the presence of chyle in the right pleural cavity can be explained in my case as there was no injury of the right pleura.

Most cases of traumatic chylothorax are due to violent, blunt force (blows and crushes) exerted upon the chest and back, and many of the cases are associated with fracture of the ribs or vertebræ. In some cases, however, there is no evidence of bony injury and the rupture of the duct is probably due to alterations in the intrathoracic pressure or to overstretching of the duct, the state of fulness of the duct possibly being of etiological importance.

Chylothorax due to stabs and gunshot wounds is extremely rare. This is to be expected considering the relations of the thoracic duct to the great vessels and heart; such an injury of the duct is very apt to be associated with a fatal wound of these structures. I can find on record only one case, besides my own, of chlothorax due to stab. Zesas has recorded two cases of chylothorax due to gunshot wounds and I have found two other cases which occurred during the recent war and were reported by Elliott and Henry.[2] These two cases occurred in the same base hospital in one month, but were the only ones in 600 samples of hæmothorax fluid examined by the authors and this laboratory figure covered far more than 1000 chest wounds. In both cases the missile passed obliquely across the apex of the thorax behind and under the left subclavian artery.

The clinical manifestations of chylothorax are those of a simple pleural effusion. Diagnosis made by aspiration and then the fluid may be mistaken for pus. A careful microscopic and chemical examination of the fluid will decide. There are seldom any subjective symptoms in non-traumatic cases except dyspnœa and weakness. Elliott and Henry think the following points may help in the differentiation of chylothorax and hæmothorax due to war wounds: In the former the effusion is more apt to be on the left side and continues to increase steadily and rapidly on the third and fourth days, causing progressive cardiac and respiratory embarrassment. Such an increase is rarely seen with an ordinary sterile hæmothorax where the bleeding is either fatal or ceases within the first twenty-four hours. It may, however, occur as the result of infection of a hæmothorax. A chylous effusion, even if infected, will not be accompanied by high fever because the patient's nutrition is profoundly impaired.

The prognosis of traumatic chylothorax is very grave and in the cases collected by Zesas the mortality was slightly over 50 per cent. Death is usually due to exhaustion from the loss of chyle. Hahn's case, in which twenty-nine litres of chyle were aspirated in the course of twenty-six days, died, but the case of Dietze, in which twenty-seven litres were removed in forty-two days, recovered.

As regards treatment it may be said that radical surgery, *i.e.*, attempts to find and close the opening in the duct, is hardly practical. Aspiration should

only be done when the pressure symptoms are very marked as the relief of pressure may increase the leakage from the duct. Thoracotomy is not recommended, though in the case of Helferich the leakage of chyle ceased after the thoracotomy, whereas it had not done so following previous aspirations. Some have suggested cutting down the fats and increasing the sugar in the diet to diminish the flow of chyle. Hall and Morgan [4] claim that all that the injured duct needs for recovery is rest, which is secured by exclusive rectal feeding, the food thus given being absorbed by the colonic lymphatics, which pour their contents into the general superficial and peripheral lymph channels instead of the lacteal system. I hardly think that experience will bear this out. In our case we intended to inject the aspirated fluid into a vein but the idea was abandoned when the fluid was found to be infected.

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AN ANOMALOUS PORTAL VEIN WITH ITS SURGICAL DANGERS

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Anomalous vessels are not uncommon but the vein herein described I think to be of such exceptional rarity as to warrant reporting. The condition recorded in this short communication was discovered in the body of a male dissecting-room subject, aged sixty, in the Laboratory of the Anatomical Department of the University of Texas. It has proven to be a remarkably interesting case of anomalous portal vein. A search through the files of the *British Journal of Anatomy and Physiology* and of the *American*

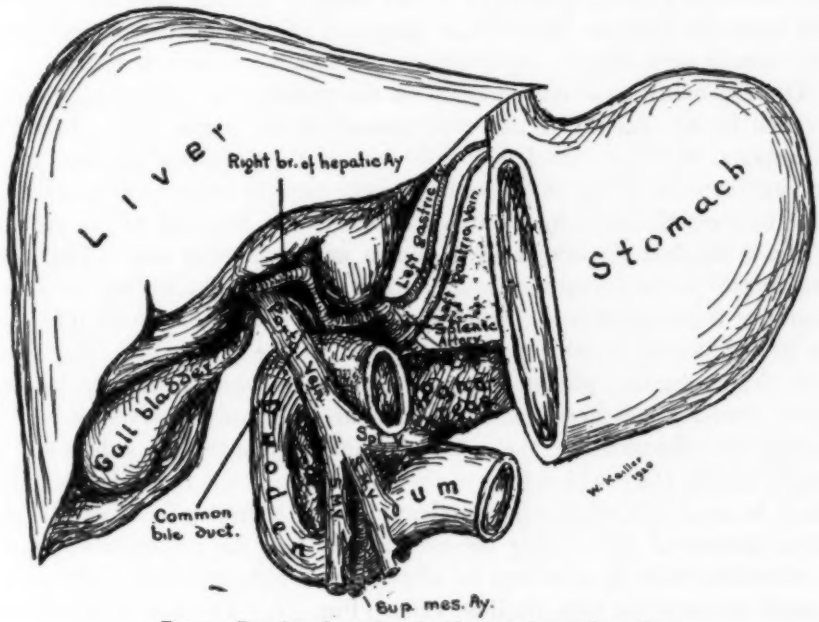

Fig. 1.—Drawing of case described from tracing made on glass.

Journal of Anatomy for the last five years did not reveal notice of an abnormal vessel like the present specimen. This anomaly is of special interest to surgeons because of its unusual and exposed position in connection with operations upon the common bile-duct.

The abnormality is formed as follows (Fig. 1): A number of tributaries issue from the hilum of the spleen which unite to form the splenic vein. The vessel then runs from the left toward the right, passing obliquely posterior to the middle portion of the body of the pancreas. It emerges from underneath the body of the pancreas just below the neck of the organ,

continuing along the summit of the duodeno-jejunal flexure. A little beyond the point immediately anterior to the head of the pancreas it is joined by two rather large veins coming upward from below in the root of the mesentery of the small intestine. These two veins, which represent the superior mesenteric vein, pass upward anterior to the horizontal portion of the duodenum and are returning the blood from the small intestines, receiving all the tributaries from this portion of the gut which correspond to the rami intestinales of the superior mesenteric artery. The portal vein formed in this manner anterior to the head of the pancreas then courses upward anterior to the upper flexure of the duodenum. At the upper border of the duodenum the vessel enters the right free border of the gastro-hepatic omentum (lesser omentum) and passes thence to the right extremity of the porta hepatic antero-lateral to the common bile-duct, and the hepatic artery. It will thus be seen that the vein lies in front of the duodenum, common bile-duct, and hepatic artery instead of behind them, as is usual, and that in operations upon the common bile-duct or glands in this region the danger to this great vein in very serious, especially as the anomaly is so unexpected.

The explanation of the anomaly in the position of this vessel must be preceded by an account of the development of the portal vein. It will be remembered that this vessel is formed out of the proximal portions of the two vitelline veins of the embryo which empty into the sinus venosus (Fig. 2). These two vessels begin by the union of radicles in the wall of the yolk-sac. In Fig. 2 the left vitelline vein is shown arising in this way. The vessel next courses in the dorsal mesentery of the fore-gut and entering the ventral mesentery it passes into the sinus venosus. It is also shown in this figure that in the dorsal mesentery the tributaries of the portal vein, the splenic which drains the fore-gut, the superior mesenteric which drains the mid-gut, and the inferior mesenteric which drains the hind-gut are developed in this situation as tributaries of the vitelline veins. In order to understand the changes taking place which lead to the formation of the normal portal vein, it must be kept in mind that the duodenum forms at first a free loop the right lateral surface of which later becomes attached to the posterior surface of the abdominal wall by a process of physiological inflammation. This loop is situated between the two vitelline veins (Fig. 3). The two vitelline veins have become united by three cross anastomoses with each other in such a manner that there is formed about the gut a cephalic and a caudal venous ring. These connections have the following positions: one transverse connection (*a*) in the liver; a middle one (*b*) behind the duodenum; and the third (*c*) caudal to the duodenum.

The development of the normal portal vein from the sides of these two venous loops with their cross anastomoses takes place in this manner: the portal sinus, which occupies the transverse fissure of the liver, is formed out of the cranial transverse anastomosis (*a*); the part of the vein in the right free margin of the gastro-hepatic omentum (lesser omentum) and behind the first portion of the duodenum is formed from the right side of the cephalic

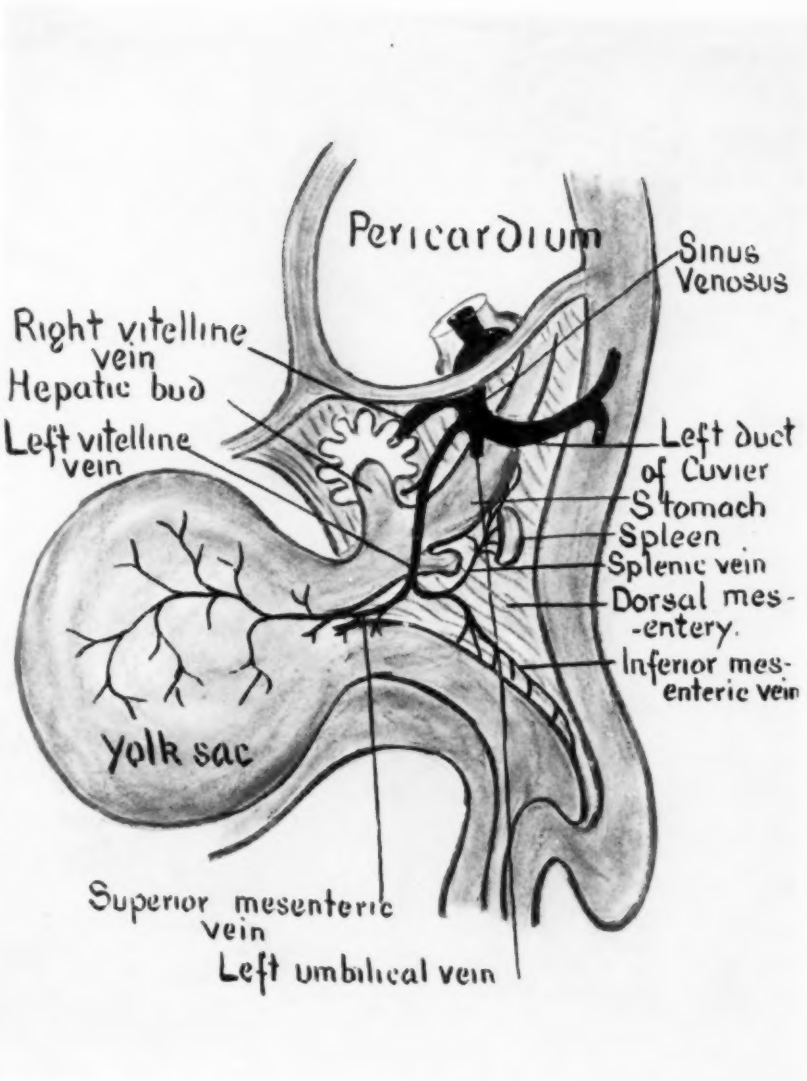

FIG. 2.—The left vitelline vein of an embryo of the fourth week. (After Keith.)

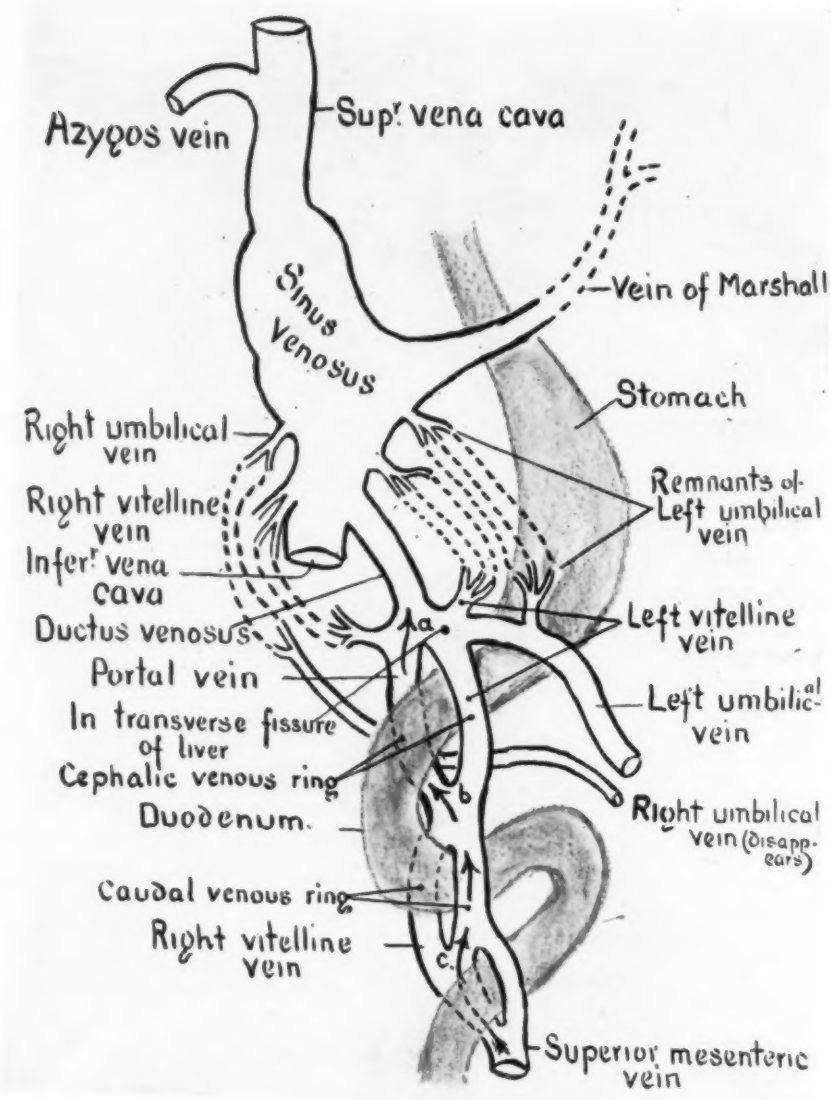

FIG. 3.—Diagram showing the formation of the ductus venosus and the fate of the umbilical and vitelline veins. The arrows show the parts of vitelline veins which become the portal vein (after Keith). (a) Cranial transverse anastomosis. (b) Middle transverse anastomosis. (c) Caudal transverse anastomosis.

loop (right vitelline vein), while the left limb of this loop atrophies and disappears; the middle anastomosis (*b*) represents the commencement of the portal vein immediately posterior to the neck of the pancreas; finally, the left limb of the caudal loop persists as the terminal part of the superior mesenteric vein, which lies anterior to the horizontal portion of the duodenum, and the right limb of this loop disappears.

In our specimen the right limb of the cephalic venous loop which surrounds the first portion of the duodenum degenerated, contrary to the rule, while the left limb persisted, with the result that the vein in this part of its course is lying directly anterior to this stage of the doudenum.

MALIGNANT NEOPLASIA IN THE GALL-BLADDER

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Notwithstanding the fact that malignant conditions of the gall-bladder have been well described in the literature, our recent observations with a large series of cases differing somewhat from those in the literature seem to justify a review of the subject.

A REVIEW OF THE LITERATURE

Three cases of cancer of the gall-bladder were reported before 1800; two by de Stoll in 1777 and one by Hallé in 1786. Baillie reported a case in 1794, but the diagnosis was questioned because the lesion resembled tuberculosis. From 1800 to 1850 seven cases were reported. Durand-Fardel, in 1840, were the first fully to describe the condition. In the latter half of the nineteenth century many contributions to the subject were made by English, French, German, and American writers, among the most important of which may be mentioned those of Rollestone, Villard, Courvoisier, Zenker, Fütterer, Musser, Ames, and Smithies, representing the medical aspect of the subject, and of those of Mayo-Robson, Moynihan, Quénu, Kehr, Erdman, Deaver, and W. J. Mayo from the surgical and prognostic aspects.

Fawcett and Rippmann, in 592 necropsies in cases of gall-stone, found malignant conditions of the gall-bladder in forty-eight cases. Dr. W. J. Mayo has stated that cancer occurred in eighty-five of 3908 operations on the gall-bladder and biliary passages in the Mayo Clinic. Erdman found the incidence of cancer in this organ to be 6.7 per cent. in 224 cases of cholecystitis in which he operated from 1917 to 1919. Deaver found 1.6 per cent. malignancy in 1000 operations for gall-stones, and Smithies has reported 2.3 per cent. malignancies in 1000 operations on the gall-bladder.

PATHOLOGY

Ziegler believes that carcinoma of the gall-bladder is of the cylindrical epitheliomatous type which takes the form of a papillary or fungous tumor, or of a cancerous ulcer. MacCallum believes that the malignancy takes the form of adenocarcinoma or epithelioma. Rollestone has found the condition to consist chiefly of carcinoma, which may be of the columnar or spheroidal-cell variety and the cells may undergo colloid degeneration. The

tumor may be papillomatous or invasive. Through metaplasia a squamous-cell carcinoma may occur. He cites references to twenty-two cases of the squamous-cell type. Primary sarcoma is considered exceedingly rare; Rollestone cites only fourteen references to this type of growth. It is believed that the growth originates in the glands in the wall of the gall-

FIG. 1 (47799).—Papillary carcinoma of the fundus of the gall-bladder.

bladder or in its mucous membrane. MacCarty and Rollestone believe that both carcinoma and epithelioma arise from the mucous membrane which lines the gall-bladder.

Rollestone states: "It may be concluded that carcinoma, whatever its form, arises from the mucous membrane as a whole, and no statement that either form of carcinoma arises exclusively from the surface epithelium of

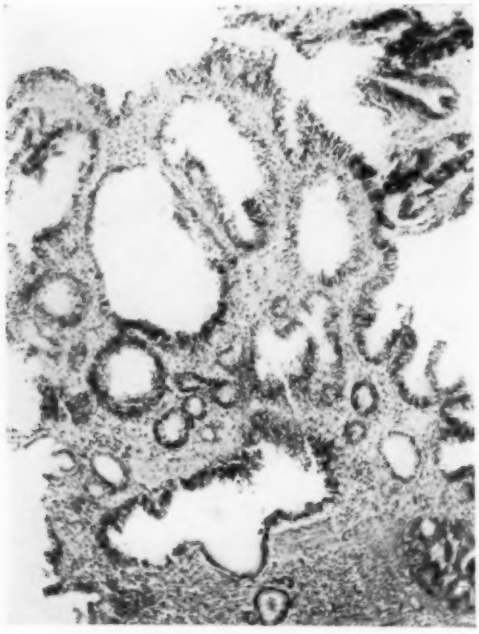

FIG. 2 (47799).—Carcinoma shown in Figure 1. x50.

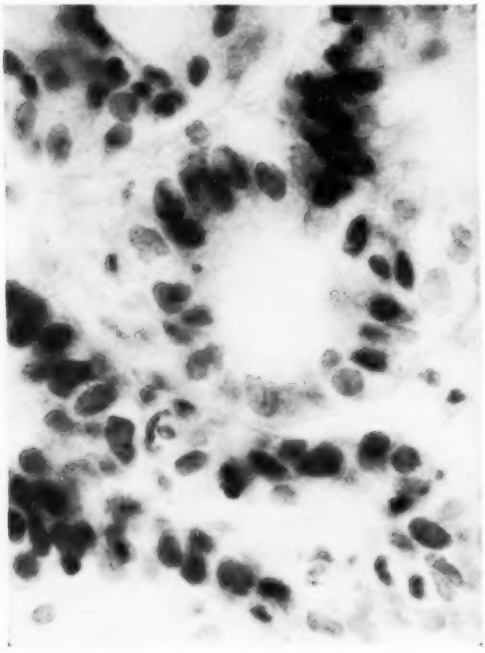

FIG. 3.—(47799).—Carcinoma shown in Figure 1. x500.

FIG. 4 (233246).—Papillary carcinoma of the gall-bladder

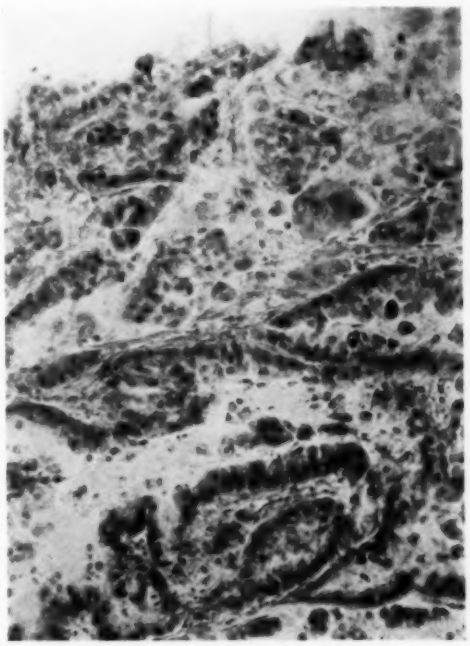

FIG. 5 (233246).—Carcinoma shown in Figure 4. x50.

FIG. 6 (197895).—Colloid carcinoma of the gall-bladder.

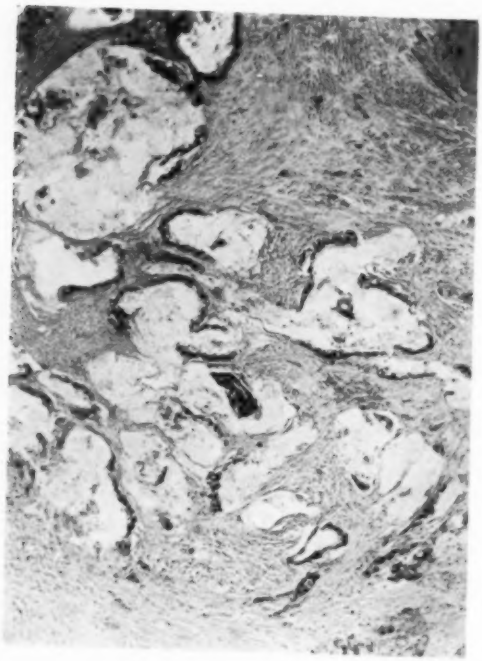

FIG. 7 (197895).—Carcinoma shown in Figure 6. x50.

FIG. 8 (197895).—Carcinoma shown in Figure 6. x50.

FIG. 9 (181245).—Diffuse carcinoma of the gall-bladder.

the gall-bladder or from the epithelium lining the glands is justified. . . . . The growth is found most commonly in the fundus, although it may occur in the neck of the organ, or be diffuse in form." Fütterer classifies his cases as follows: Seventeen in the fundus, thirteen in the neck, eight in the anterior wall, and seven in the posterior wall.

ETIOLOGY

Malignancy of the gall-bladder is shrouded in the same cloak of mystery as is cancer in general. Many writers believe that the chief causal factor is the local irritation of gall-stones, which are present in a large percentage

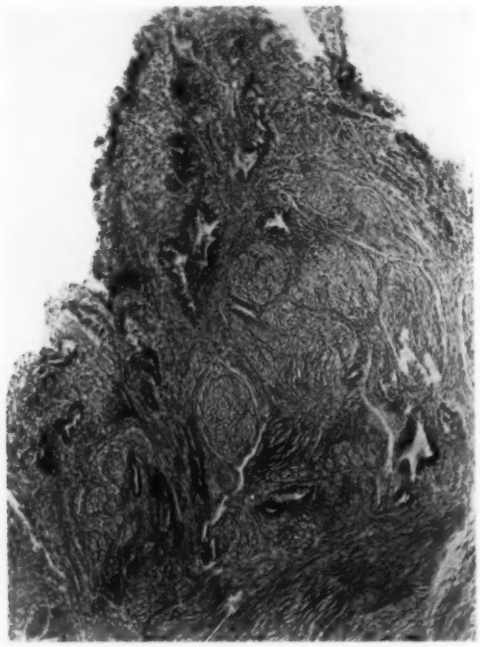

FIG. 10 (181245).—Carcinoma shown in Figure 9. x50.

of the reported cases. Musser found stones in primary malignant disease of this organ in 69 per cent. of cases, Fütterer in 70 per cent., Winton in 81 per cent., Zenker in 85 per cent., Courvoisier in 91 per cent., Siegert in 95 per cent., Janowski in 100 per cent., and Deaver in 89 per cent. Beadles found sixty-four cases of secondary malignancy, with stones in two instances. Siegert found stones in 15 per cent. of secondary malignancy. Whether the stones are the cause or the result of the growth has been widely discussed. Lutton, Lancereaux, Lang-Heinrich, and Förster favored the view that the growth precedes the stones. It was suggested that the neoplastic condition causes stagnation and inspissation of the bile with a resultant formation of stones. It is now generally conceded that the stones precede the growth.

Various English writers claim heredity as a factor in from 11 to 17 per cent. Schueppel denies this. In Smithies' series a history of heredity was found only once.

AGE AND SEX INCIDENCE

Cancer of the gall-bladder shows a predilection for females; Zenker found 72.9 per cent. in women; Naunyn 83 per cent.; Musser seventy-five females to twenty-three males. Smithies, on the other hand, reported sixteen males to seven females. The condition is usually observed between the ages of fifty and seventy. Sherrill gives the average age as fifty-four and five-tenths years, Smithies as fifty-nine years, and in Musser's cases the ages were as follows:

Years	Patients
1 – 10	1
11 – 20	0
21 – 30	1
31 – 40	9
41 – 50	19
51 – 60	29
61 – 70	19
71 – 80	14
81 – 90	1

Ames reported the case of a boy aged four.

The clinical picture in our cases does not differ from that described in the literature. Lancereaux divided malignancy of the gall-bladder into a biliary form characterized by belching, abdominal cramps, dyspepsia, jaundice, abdominal mass, and fever, and an hepatic form with an insidious onset, short duration, vague abdominal pains, weakness, diarrhœa or constipation, rapid enlargement of the liver, and occasional slight jaundice. Guyot added three other groups, chiefly dependent on the symptoms produced by adhesions of the malignant gall-bladder to other organs; pseudopyloric symptoms, intestinal symptoms, or symptoms due to perforative peritonitis. Rollestone divides the cases into those in which the symptoms are associated with preëxisting cholelithiasis, those in which the symptoms are due to the local effects of the disease, and those in which they are due to invasions of the adjacent parts by the growth and to metastasis in the liver, peritoneum, or elsewhere. W. J. Mayo mentions the following diagnostic clinical points in connection with the diagnosis: A hard tumor in the region of the gall-bladder, absence of rigidity unless the peritoneum is involved, progressive loss of flesh and cachexia, a nodular tumor if the liver is involved, and jaundice if the ducts are involved.

SURGICAL TREATMENT

Bardenheuer was probably the first to extirpate the gall-bladder for cancer. Hochenegg next performed the operation; his patient had not had a relapse at the end of eight months. When the tumor is confined to the gall-bladder cholecystectomy is generally conceded to be the operation of choice. In some cases a portion of the liver may be removed, as was first advised by Mayo-Robson, although when it is necessary to remove a large portion, poor results may be expected. Cotte speaks of palliative and radi-

FIG. 11 (35874).—Diffuse carcinoma of the gall-bladder with adjacent liver tissue.

cal operations, that is, cholecystostomy, which should be reserved for the badly infected cases, or for those in which there is considerable retention in the gall-bladder, and cholecystectomy with the removal of the neighboring lymphatic glands and the excision of adjacent liver tissue. The results of surgical treatment of malignancy of the gall-bladder as gleaned from the literature are far from satisfactory. W. J. Mayo, in 1910, reported five patients alive after two years. In these a preoperative diagnosis of malignancy was not made. One patient whose diagnosis was made preoperatively lived more than one year. Smithies reported the cases of two patients who

have remained well more than four years; all the other patients in his series died within eight months. Quénu, in ninety-three collected cases, reported results as follows: Death in less than three months, seventeen; death between three and four months, seven; death between four and six months, six; death between six and eight months, eight; death between eight and twelve months, one; death at the end of one year, three.

Friedham reported a patient alive and without relapse after four and

FIG. 12 (314451).—Diffuse carcinoma of the gall-bladder.

one-half years; Worner, after three years; Körtze, after two years and two months; Mayo-Robson, after two years; Friedham, after three years, but dead after four years; Hochenegg, dead after three years; and Patel, dead after two and one-half years. Quénu gives the immediate mortality as being due to hemorrhage, syncope, septicæmia, peritonitis, and shock.

From January, 1907, to January, 1921, 7878 operations were performed for gall-stones at the Mayo Clinic. Within this period primary malignancy of the gall-bladder (confirmed by pathologic examination) occurred in eighty-four cases (carcinoma eighty-two cases; epithelioma one; and lymphosarcoma

one). The carcinomas were divided into the adenomatous and the colloid types, the adenomatous type being much more frequent and taking the form of papillary or ulcerative growths, with a general thickening of the walls. Thirty-four gall-bladder specimens were available. In twenty-three the condition was a diffuse form of carcinoma with a general thickening of the walls of the gall-bladder. The fundus was no more frequently involved than the pelvis. In four the cancer was of the fundus, in three the condition was the flat ulcerative type, and one was of the papillary type. There was one papilloma of the middle portion, one of the pelvis, and three flat ulcerative

FIG. 13 (314451).—Carcinoma shown in Figure 12. x50.

growths at the neck of the organ. The epithelioma was situated at the fundus; the lymphosarcoma involved both the fundus and the pelvis.

In the series of eighty-four cases there were thirty-eight cholecystectomies and forty-six explorations. Stones were found in thirty-seven of the thirty-eight cholecystectomies. Stones were definitely present in thirty-three cases in which explorations were performed; they were undetermined in twelve and absent in one. The epithelioma was unaccompanied by stones, while the lymphosarcoma was associated with them. In a number of instances the growth was situated so that there could be no interference with bile drainage, thus probably disproving in these cases the hypothesis that the neoplastic obstruction produced the stones.

In only nine cases was there a history of hereditary or family cancer. Sixty-eight of the patients were females; sixteen were males. The ages were as follows:

Years	Patients
1 – 10	0
11 – 20	0
21 – 30	2
31 – 40	2
41 – 50	12
51 – 60	37
61 – 70	27
71 – 80	3

SYMPTOMATOLOGY

The average duration of symptoms was from ten to thirty years, the longest duration was more than forty years. One patient had felt perfectly well until one month before operation; an inoperable carcinoma was found.

The average loss of weight was fifteen pounds. One patient had lost fifty pounds; another had gained in weight.

Sixty patients gave a definite history of gall-stone colic. Thirty-two complained of a dull pain either with or without colic. The pain was situated in the epigastrium in forty-three cases; in the right hypochondrium in forty-four; in the upper left abdomen in six; and in the lower abdomen, back or precordial region each in one. The pain radiated to the back in thirty-eight cases; to the right shoulder in eleven; to the left shoulder in four, and to the right iliac fossa in two. Eusterman has called attention to the frequency of pain in the back in cases of malignancy of the gall-bladder. Thirty patients had pain so severe as to require morphia for relief. One patient was given chloroform.

Forty patients had varying degrees of jaundice. Forty-seven had vomited and fifty had been nauseated; forty-three had been constipated, and one had had diarrhœa.

Twenty-three patients gave a history of fever.

Forty-nine patients complained of tenderness on palpation; in forty the tenderness was in the right hypochondrium, in nine in the epigastrium. A mass was palpated in thirty-seven; in thirty-two in the right upper abdomen; in three in the epigastrium; in one in the middle abdomen, and in one in the lower abdomen. The liver was definitely palpable in seven patients; one only had physical signs of ascites.

Test meals were given to thirty-three patients and achlorhydria was found in one, subacidity in nineteen, normal acidity in twelve, and hyperacidity in one.

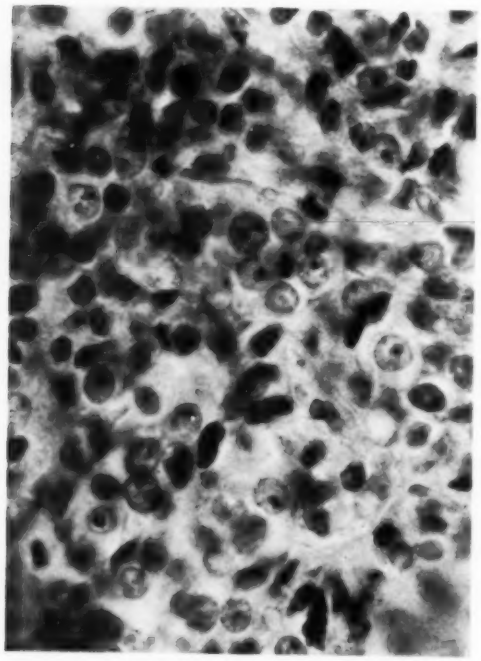

FIG. 14 (314451).—Carcinoma shown in Figure 12. x500.

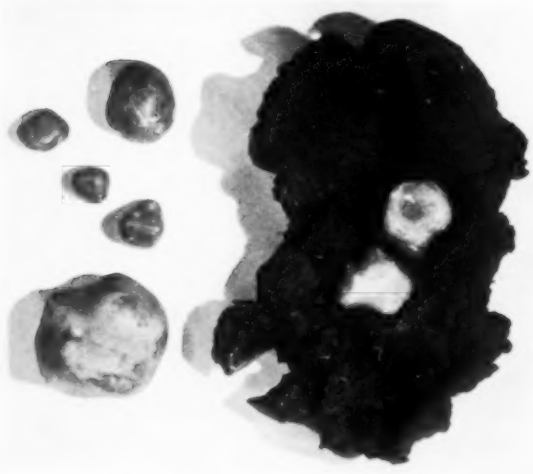

FIG. 15 (27259).—"Innocent" gall-stones.

FIG. 16 (163101).—Epithelioma of the gall-bladder.

FIG. 17 (163101).—Epithelioma shown in Figure 16. x 50.

DIAGNOSIS

It is extremely difficult to diagnose malignant conditions of the gall-bladder early enough to obtain favorable results from surgical treatment. Usually the chief symptoms are those of gall-stones, and there does not seem to be any additional chain of symptoms whereby the onset of malignancy can be foretold. Rapid loss of weight and strength, pain referred to the back, and a mass with or without jaundice, indicate advanced malignancy in some cases. Malignancy in the bile ducts or in the pancreas can scarcely be differentiated. Severe cholangitis with or without stones in which there is

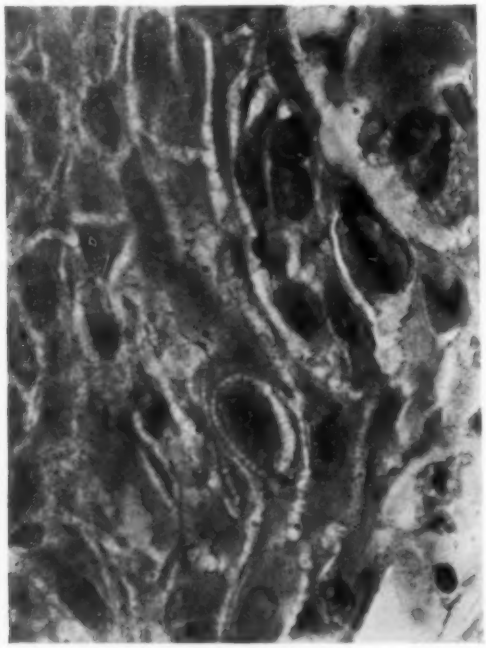

FIG. 18 (163101).—Epithelioma shown in Figure 16. x1000.

a rapid loss of weight may be confused with neoplasia. Empyema of the gall-bladder may simulate malignancy.

In the thirty-eight cases of cholecystectomy a diagnosis of gall-bladder disease with or without stones was made in twenty-five; in five a questionable diagnosis of cancer of the gall-bladder was mentioned, while in one, cancer of the liver was diagnosed.

In the forty-six explorations, gall-bladder disease was diagnosed in twenty-two cases, malignancy of the gall-bladder in twelve, and of the liver in three.

TYPE OF OPERATION

Cholecystectomies were performed in thirty-eight of the eighty-four cases. In six of these a portion of the liver was also removed, and in one three-fourths of the common duct was resected. Choledochotomy was performed

in five. In forty-six cases the condition was considered inoperable from a radical point of view. A partial cholecystectomy was performed in four, cholecystostomy in ten, and choledochotomy, appendectomy and posterior gastro-enterostomy each in one case. In the cases in which the gall-bladders were removed the growth had extended to the liver in nine, to the biliary ducts in four, to the pancreas in three, and to the lymph-glands in five. Explorations showed that the growths had extended to the liver in thirty-seven, to the bile ducts in two, to the lymph-glands in thirteen, to the pancreas in three, to the stomach in three, to the colon in four, to the duodenum in two, to the small intestine in four, to the operative incision in one, to the peritoneum in three, to the omentum in two, to the pleura in one (necropsy), to the left lung in one (necropsy), and to the pelvis in one.

PROGNOSIS

The operative mortality in the series reported was not exceedingly large. One patient died within the two weeks following cholecystectomy. Seven died within the two weeks following exploration; a total of eight of eighty-four patients.

TABLE I

RESULTS OF OPERATION

Exploration		Cholecystectomy	
Duration of Life	Patients	Duration of Life	Patients
		Years	
1 week	5	1	1 *
2 weeks	2	2	5
		(Three still alive.)	
3 weeks	1	3	1
1 to 2 months	9	4	1
2 to 3 months	6	5	0
3 to 4 months	2	6	1
4 to 5 months	2	7	1
		8	2
5 to 6 months	4	(One still alive.)	
		9	1
7 to 8 months	2	(Still alive.)	
8 to 9 months	0	10	1
		11	1
9 to 10 months	1	(Still alive.)	
10 to 11 months	1	12	0
Alive 11 to 12 months	2		
Alive 2 years after operation	1	Months	
Alive 1 year after operation	1	1	3
		2	1
		3	0
		4	3
		5	0
		6	2
		7	2
			26
Seven patients could not be traced.		Twelve patients could not be traced.	

* Patient alive one year after operation; not heard from since.

The cases are divided into three groups:

Group 1.—Cases in which after symptoms of gall-stone colic for years there is a sudden change; the patient begins rapidly to lose weight and strength, the pain becomes continuous; jaundice, fever, and a tumor may or may not be present.

FIG. 19 (342964).—Lymphosarcoma of the gall-bladder, with adjacent liver tissue.

Group 2.—Cases similar to those in Group 1 with the exception that instead of symptoms of gall-stone colic there are symptoms of gall-bladder dyspepsia.

Group 3.—Cases in which there are no symptoms up to one year before operation, then a sudden development of symptoms of malignancy, rapid loss of weight and strength, cachexia, and tumor. Jaundice may or may not be present. Some of these patients may have pain, either of a dull boring character, or that of gall-stone; others may not have pain.

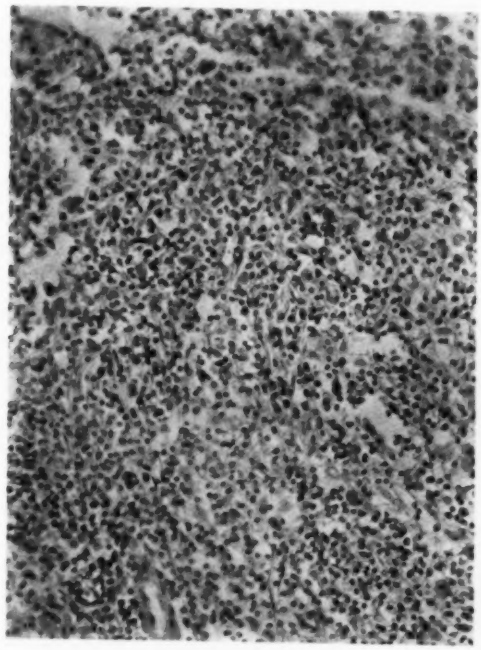

FIG. 20. (342964).—Lymphosarcoma shown in Figure 19. x50

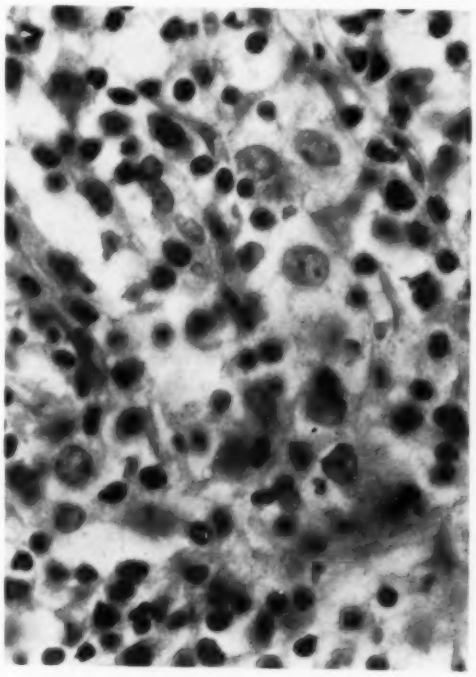

FIG. 21 (342964).—Lymphosarcoma shown in Figure 19. x500.

The forty-six cases in which exploratory operations were performed are divided into three groups: thirty cases in Group 1; five cases in Group 2; and eleven cases in Group 3.

DISCUSSION

Twenty-nine of the thirty-eight patients on whom cholecystectomies were performed had had symptoms referable to the gall-bladder for more than one year; nine had had symptoms for less than one year.

If the condition is operable cholecystectomy should be performed; cholecystostomy should only be performed when besides the tumor there is a severe infection of the gall-bladder, or as a path for the introduction of radium (W. J. Mayo).[28] Cholecystostomy for stones had been performed elsewhere in five of the eighty-four cases, indicating that malignancy may develop in gall-bladders that have been drained.

W. J. Mayo[26] considers jaundice a contraindication to operation when a definite diagnosis of malignancy of the gall-bladder has been made.

Complications may be due to perforation of the gall-bladder, as happened in one case in the series, to empyema, or to extension to the neighboring viscus by continuity, contiguity, or metastasis.

Seven patients on whom a cholecystectomy had been performed were alive six years after operation, a percentage of 8.3 cures. The diagnoses in these cases were: gall-stones in three, gall-bladder disease in three, and gastric carcinoma in one (in this case adhesions had developed between the gall-bladder and the pylorus). The operative procedures were: cholecystectomy in five; cholecystectomy, excision of adjacent liver tissue, and choledochotomy in one; cholecystectomy and gastroenterostomy in one (besides the malignancy there were gastric and duodenal ulcers).

CONCLUSIONS

1. Malignancy of the gall-bladder is not an uncommon occurrence.
2. Carcinoma is the most common type of neoplasia found; sarcoma is exceedingly rare.
3. Gall-stones are complications in a very large number of cases.
4. Heredity seems to have little influence in the development of malignancy in this organ.
5. Females and males are afflicted in the ratio of about four to one.
6. Seventy-five per cent of cases occur between the ages of fifty and seventy.
7. In most cases there has been a history of gall-stones for some time.
8. Early cholecystectomy for stones will either prevent the development of malignancy or find the condition in its incipiency.
9. Late operation is of little value except as a diagnostic procedure.

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PERFORATING GASTRIC AND DUODENAL ULCER*

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Perforating ulcer of the stomach or duodenum is not common, yet it is a sufficiently frequent and serious calamity to merit the most respectful consideration. From a survey of the cases which have occurred in the surgical clinic at the University Hospital, surgery has not proven as efficacious as could be desired. The lesson gleaned from a careful study of these cases is, that surgery has failed to meet its obligation, in that there has been less than 50 per cent. of cures. It is begging the question and shunting responsibility to excuse surgery for these poor figures by replying there would have been 100 per cent. failures if medical treatment alone were used. Apparently after rupture, no matter how quickly these cases come under the knife, somewhere around one-half will perish. This is a fearful mortality. Despite proper drainage and early operation and the Fowler position, as far as this clinic is concerned one out of every two cases is doomed. Apparently, therefore, improvement in the mortality rate is not to be sought so much in operating early after perforation, but in interference before rupture. As soon as perforation occurs the patient is gravely ill, previous to this catastrophe he is sick, but in most instances a good surgical hazard. Consequently after a diagnosis of a chronic ulcer of the stomach or duodenum temporizing measures are inexcusable, as chronic ulcer of these structures from the onset is a surgical condition and amenable alone to surgery. Like appendicitis, one is never assured that ulcer of the stomach or duodenum is cured. The patient might go along for a long period in comparatively good health and then, like a flash of lightning out of a clear sky, he will be struck down with agonizing pain, located principally in the epigastrium. The suddenness of the onset, the intensity of the pain and the board-like rigidity of the overlying muscles, together with a history of previous gastric disturbances, especially hunger pains coming on one, two, three hours after eating which are relieved by ingesting more food, make the diagnosis. It should be borne in mind, however, that in some of these cases the patient never has any symptoms referable to the digestive organs, and is struck down suddenly. These instances are fortunately very rare. The case histories presented below are not adduced as brilliant examples of surgical successes, but for the purpose of urging operation before rupture when the procedure is not overly dangerous to the patient's chance for recovery.

Of the 29 cases 14 recovered, 48.38 per cent.; 15 died, 51.72 per cent.; 27 were men, 2 women; 27 were white, 2 colored. Both of the colored patients were men. Their ages were 50, 60, 38, 50, 59, 23, 58, 29, 23, 21, 47, 35, 43,

* From the surgical clinic of the University Hospital, Baltimore.

55, 34, 30, 32, 36, 29, 53, 37, 54, 65, 22, 53, 44, 58, 39, 29 years, respectively. These were divided into decades as follows:

20 – 30	30 – 40	40 – 50	50 – 60	60 – 70
7	8	3	9	2

The youngest was 21, the eldest 65 years of age.

The occupations were: waiter 1, stevedore 1, housewife 1, druggist 1, patternmaker 1, seamen 2, laborers 5, shoemaker 1, stationary engineer fireman 1, painter 1, engineer 1, machinists 1, carpenter 1, foreman 1, farmers 3, not given 7. Sixteen were of the gastric type, 13 duodenal.

The following operations were done: Enterorrhaphy, 9; gastrorrhaphy, 7; posterior gastroenterostomy, 1; gastrorrhaphy and posterior gastroenterostomy with Murphy button, 1; gastrorrhaphy and posterior gastroenterostomy, 5; exploratory laparotomy and drainage, 1; pylorectomy and posterior gastroenterostomy, 1; exploratory laparotomy, died on table, 1; enterorrhaphy and posterior gastroenterostomy, 2; enterorrhaphy and appendectomy, 1.

In all of these cases, number 25 excepted, drainage was made use of in some form. In most of them the pelvic basin was also drained.

As far as recovery was concerned it did not seem to make any material difference what type of operation was chosen.

The causes of death were septicæmia, generalized peritonitis, toxæmia, subphrenic abscess and pneumonia.

In all of the cases with the exception of No. 28 the ulcer was situated in close proximity to the pylorus. In the latter the rent was in the anterior wall of the stomach close by the cardiac orifice. In reporting a series of cases it is usually the custom for one to put his best foot forward and record those instances only in which he has been succesesful. This is the wrong attitude to assume, as equally as valuable information may be obtained from fatal as successful issues. The above series is not a brilliant example of operative cures. If the operators had been looking for a record the fatality list could have been somewhat reduced by refusing to operate on a few of these cases, as they were in very poor shape when they came to the operating table. The chief lesson to be gained by a close perusal of the histories of these cases is that no matter how early they come to the operating table after rupture, there will be a mortality approaching 40 per cent. Of the above series fourteen cases were received in the clinic within twelve hours after the rupture, of whom six died, 42.8 per cent. This being true the question naturally arises, can't something be done to prevent this terrible mortality? To a very large extent the deaths were of men and women in the full bloom of life. It represents a huge economic loss to the City, State and Nation. It is agreed that the sooner the victim of perforation of the upper digestive tract is received the better his chance of recovery. If, however, the mortality is somewhere around the figures enumerated, then surgery after rupture is somewhat lacking in its obligations, and relief must be sought elsewhere. It is begging the question to say that 100 per cent. of deaths would have occurred if medical means had been employed.

Of the twenty-nine cases twenty-three gave histories of stomach disturbances extending over a period of a few weeks to many years. In most of these the history was typical of ulcer. In fact, a few had even been diagnosed as ulcer. Leaving out of the question that carcinoma of the stomach is supposed to be preceded in at least 60 per cent. of the cases by ulcer and the other debilitating disorders incident to ulcer, the fact alone that 50 per cent. of the cases of perforating ulcer of the stomach or duodenum are doomed, should arouse the profession to the seriousness of this complication. Both the profession and the public have been educated to the importance of having a diseased appendix removed before it ruptures. In the first instance the procedure is a comparatively safe undertaking, in the latter the outcome is not so assured. Ulcer of the stomach or duodenum may be symptomatically benefited by medicinal agents, but there is no assurance that it is ever cured. Here as in appendicitis a comparatively safe operative procedure may be instituted for a problematical, namely a gastroenterostomy or a pylorectomy with a gastroenterostmy. If perforating ulcer is to be avoided and life preserved the profession must bring the ulcer case to operation before rather than after rupture. I am fully aware that the responsibility resting upon the internist is great in recommending operation in conditions of the upper abdomen, but if a worse catastrophe is to be avoided, the victims of chronic indigestion and of hunger pains relieved only by further eating must be brought to the surgeon earlier. This is the lesson that this series teaches. Discite moniti.

CASE REPORTS

CASE I.—J. P., white, male, aged fifty, was admitted to the University Hospital on December 1, 1908, with the history of having been ill for three weeks. The trouble began with acute abdominal pain located for the most part in the epigastrium. After a few days this pain subsided somewhat, but he continued to run fever, his pulse continued to be accelerated and the abdomen remained distended. When brought to the hospital he gave the appearance of being very septic, his pulse was very rapid and thready, temperature irregular. His abdomen was noticeably distended and rigid throughout. Meteorism was extreme. He was immediately placed in the upright position and protoclysis administered and his abdomen packed with ice. The meteorism was gradually relieved by numerous enemata. A diagnosis of generalized peritonitis, probably the result of a ruptured appendix, was made.

Two days after admission a low right rectus incision was made and upon opening the peritoneal cavity a large quantity of thick pus containing numerous flakes of fibrin was evacuated. The appendix when delivered was but slightly inflamed and was not the cause of the peritonitis. Consequently a hand was introduced into the upper abdomen and released a large collection of pus. The incision, therefore, was extended upwards to enable a better inspection of the upper digestive tract. This manœuvre demonstrated a perforated duodenal ulcer. After separating the duodenum from the liver, to which it was adherent, the hole in the bowel was sutured. Further search revealed another abscess which was also evacuated. This abscess had for its wall the duodenum, the liver and omentum. At this stage of the operation the patient's condition was so critical that drainage tubes were hurriedly placed in the pelvis, subhepatic space and through a counter-

opening in the right loin, the wound closed down to the drains and the patient gotten off the table. After being put to bed the man gradually recovered from his shock, but for some days his course was very stormy and his convalescence was complicated by a bilateral pleurisy. However, he finally fought down his peritonitis and pleurisy and was discharged from the hospital on January 21, 1909, cured.

Case II.—This patient, a white man who could speak but little English, was admitted to the hospital January 2, 1909, with the complaint of severe pain in the upper abdomen. He was about sixty years of age. Examination revealed an abdomen, concave in its upper portion, convex in its lower. The abdominal wall was very rigid and tender, but most sensitive in its upper right quadrant. There was no history of vomiting. The rectum was distended, but nothing abnormal could be palpated. Operation was advised, but refused until the next morning, January 3rd, when he accepted. By this time, however, his condition was almost hopeless.

Operation January 3, 1909, ether anæsthesia, iodine technic, gastrorrhaphy, died. The abdomen was opened by a midline incision. On reaching the peritoneum a quantity of gastric contents was found lying free in the peritoneal cavity. After mopping this up, further search developed a ruptured ulcer in the anterior wall of the stomach, situated in close proximity to the pylorus. This was closed. The man's condition did not warrant further interference, so free drainage of the peritoneal cavity was hastily applied, the wound closed as far as practical and the patient returned to his bed. He was by this time in a moribund condition, failed to rally, and died several hours thereafter.

Case III.—H. M., male, colored, aged thirty-eight years, waiter, married, was admitted to the hospital slightly after midnight, January 9, 1909, with the complaint of intense abdominal pain, which began about one hour before admittance. The patient had had very little illness previous to a year ago, to which his present illness dates. He had been a waiter for the past eight years. His meals were eaten at very irregular intervals, and he would often munch food between meals. Very often he would taste soups and liquids of various kinds when they were hot. About a year ago he began to suffer with pain and fullness about the stomach. He was treated some time for indigestion, but was not relieved. He lost about thirty pounds in weight during the last six months of his sickness. The pain was most severe about one hour after eating. At times it would cause him to stop work and sit down. About an hour previous to admission he was sitting down to eat, when he was seized with a violent pain in the upper abdomen, just about the median line, one and a half inches below the ensiform cartilage. He was brought to the hospital in an ambulance and placed in bed. Examination showed the following: The abdomen was very rigid, so much so one could not palpate deeply at all. It was concave from the xiphoid cartilage to the umbilicus, and convex from this point to the pubes. It was tender over the entire right side, more so over the gall-bladder region. The pain was severe and constant. The temperature by mouth was 97⅘ degrees F., by rectum 99⅘, pulse 90, respiration 24. His expression was quite anxious, the tongue dry but clean. When an operation was mentioned to the patient he expressed himself as not caring what was done, so he was relieved. Nothing could be palpated in the pelvis by rectal examination. The man's bowels had not moved for twenty-four hours. An ice-bag was placed over the gall-bladder region and one ounce of magnesium sulphate was administered, also morphia and the patient made ready for operation. Seven hours later his bowels had not moved. He had not vomited. An enema was given which was not effectual. A second was administered with the tube inserted well up into the rectum. This likewise did not prove effectual and the fluid had to be siphoned off.

Operation, January 9, 1909, ether anæsthesia, iodine technic, gastrorrhaphy and posterior gastroenterostomy by Murphy button, recovered. The abdomen was opened through a midline incision extending from the ensiform cartilage to the umbilicus. As soon as the peritoneum was opened, gastric contents were found free in the peritoneal cavity. After sponging out the escaped material, the stomach was exposed and a perforated ulcer found in the anterior wall of the pylorus. The opening was about the size of a dime. There was a mass of adhesions around the gall-bladder which was itself tied down to the pyloric end of the stomach. These were broken up, thus releasing the gall-bladder from the stomach. The ulcer was closed with fine silk sutures and a posterior gastroenterostomy was made by means of a Murphy button. The patient's abdomen was drained with rubber tissue tucks, one being placed in the lesser peritoneal cavity. The incision was closed down to the drains and the patient sent back to bed. Nothing was permitted by mouth for forty-eight hours; during this period fluid was administered by means of normal salt enemata. Convalescence was smooth and uneventful and the patient was discharged from the hospital four weeks after entrance, cured.

Case IV.—J. S., white, male, aged fifty, stevedore, entered the hospital July 31, 1909, with the complaint of pain in the abdomen. About two hours before coming to the hospital, the patient was seized with violent pain in the abdomen, which gradually grew worse. The stomach symptoms date back two years, during which period he had intermittent pain in his stomach and indigestion for which he received treatment under the diagnosis of gastritis. The pain was more marked about one hour after meals. The distress did not cease, but continued to grow worse until July 31, 1909, on which date he was brought to the hospital. The patient had never vomited and until now he had never had any alarming symptoms. Five hours previously he was seized with a severe pain in the abdomen. It was most pronounced in the upper right quadrant. There were no clinical findings other than marked muscular rigidity and tenderness over the entire abdomen, with the point of maximum intensity in the upper abdomen. The pain was very sharp and lancinating. His mouth was dry and tongue coated. There was no tympanites, yet there was some little distention in the lower abdomen, which was concave above and convex below. Rectal examination bore no results. The leucocyte count was 13,500, the temperature 99⅘ degrees F., pulse 105, respiration 50.

Operation, July 31, 1909, ether anæsthesia, iodine technic, gastrorrhaphy and posterior gastroenterostomy, recovered. The abdominal incision was made to the right of the midline and extending two inches above and below the umbilicus. Upon opening the peritoneum, gastric contents were found lying free between the coils of the gut. The extravasated material was mopped up. Search for the source of the leakage revealed a perforated ulcer in the anterior wall of the pylorus. This was closed with a purse-string suture and a posterior gastroenterostomy made. The upper abdomen was drained as well as the pelvis through a stab wound above the pubes. The patient was then returned to bed and placed in an upright position. He was not allowed anything by mouth for forty-eight hours, after which he was permitted ice and one ounce of water every two hours. The next day he was given liquids and two days thereafter was placed on soft diet. For the first twenty-four hours drainage was profuse, after which there was very little discharge. The temperature after operation never exceeded 101 degrees F., and the pulse 105. The respirations came down to normal soon after the operation. The man was discharged August 15, 1909, cured.

Case V.—M. E. M., white, female, aged fifty-nine, married, housewife, of Baltimore, was admitted to the hospital June 18, 1912. She had been suffering with vague stomach symptoms for four days, for which she had taken bismuth,

ordered by her family physician. She was suddenly taken worse and in the emergency called in Dr. W. H. Smith. At the time he first saw her she was suffering agonizing pain in the upper abdomen which had come on suddenly and was so severe as to evoke cries. The pain was peculiar, coming on in paroxysms, the intensity abating and increasing alternately. At this time there was little rectus rigidity or distention of the abdomen, but constipation was marked. As the patient was extremely sick she was ordered removed to the hospital where she arrived about 8 P.M. At that time her pulse was slow and nausea was present. As soon as she could be put to bed and made comfortable, a hydrogen peroxide enema was administered. This proved effectual and she became more comfortable. The improvement lasted until 4 A.M., when the pain in the abdomen recurred. At that time the pulse was 60, respiration 18, temperature 97⅘ degrees F. There was some abdominal rigidity and tenderness, but not so great as one would suppose for so severe a catastrophe. The indications for laparotomy were plain.

Operation, June 10, 1912, ether anæsthesia, iodine technic, gastrorrhaphy, died. A high right rectus incision was made. Upon entering the peritoneal cavity stomach contents were found, directing attention immediately to the character of the lesion which previously had been suspected. The source of the leakage was a small hole on the anterior aspect of the stomach near the pylorus. The opening was sutured and four drains inserted, two cigarette and two rubber tubes. The wound was closed to the drains. The next day, June 20th, the dressing was removed, but little drainage had occurred. On June 21st, the temperature began to rise until it reached 102⅘ degrees F., when the patient died. There was no apparent reason for the unfortunate outcome. At operation there was a generalized peritonitis, but as the woman was placed in the upright position, a favorable outcome was anticipated, especially as a rubber tube and a cigarette wick had been placed in the pelvis.

CASE VI.—F. F. W., white, male, aged twenty-three years, druggist, entered the hospital, January 8, 1914, with the complaint of pain in the stomach. The pain began about 8 P.M., a short while after eating a hearty supper. It was sudden in onset, cramplike, and situated about the middle of the abdomen. The hurt was so severe as to compel the patient to go to bed, but his condition becoming so alarming he was brought soon thereafter to the hospital. Up to December, 1913, the past history was negative. About that time he had an attack of pain in the epigastrium which came on about two hours after eating dinner. This discomfort and pain was relieved by eating a light supper. The next day he had a similar attack, but that one did not last so long. Following those attacks at intervals the patient had some accumulation of gas and eructation. Five days after the first attack the patient was taken suddenly at midnight with severe pains around the umbilicus and epigastrium. That attack lasted all night; but after eating breakfast he felt better. He had no further trouble until the day of admission. The general examination revealed nothing abnormal, except a markedly anxious face. The abdomen was very rigid and exquisitely tender, especially in the right side. There was no tympanites. The pulse was 100, the mouth temperature 97 degrees F., rectal 100. Immediate operation was advised and accepted.

Operation, January 8, 1914, ether anæsthesia, iodine technic, enterorrhaphy, recovered. An upper right rectus incision was made. Upon entering the peritoneum a large quantity of turbid fluid was found in the abdominal cavity and the evidences of a more or less widespread generalized peritonitis. The appendix was located and found to be normal. A search in the upper abdomen discovered the source of the trouble to be a perforated duodenal ulcer near the pylorus. The opening was closed with a purse-string suture and the line of suturing reinforced with an omental graft. Drainage of the pelvic basin was obtained by

a counter-incision above the symphysis. The original incision was closed down to the drains which had been placed in the upper abdomen. The patient was returned to his room in good condition. The convalescence was uninterrupted and the man was discharged February 12, 1914, cured.

CASE VII.—J. G., white, male, aged fifty-eight, came to the hospital September 18, 1914, with the complaint of a lump and pain in the abdomen. About two weeks previous to admission the patient was taken with a rather acute pain in the abdomen. This was severe and cramplike. He had been working up to that time, but with the onset of the trouble he was forced to quit work because of pain and weakness. He had had some fever, also nausea, but did not vomit. He stated that for a number of years he had been annoyed with stomach trouble, such as pain, pyrosis, and bad digestion. During the last year of his sickness he lost fifteen pounds in weight. On admission the pain in the abdomen was not so severe, but he was considerably bothered with flatulency. When the gas was expelled he experienced much relief. Several days after the onset of the trouble the patient noticed a lump in the left side just below the costal margin. By the time he had come in the hospital it had increased somewhat in size and was rather tender to the touch. He had an anxious expression, was very emaciated and his abdomen was slightly distended. The abdominal muscles were quite rigid. The entire abdomen was tender, so much so that a satisfactory examination was impossible. He complained of some intraabdominal pain, located principally in the upper quadrants. On the left side about two inches below the costal margin could be felt a nodular tumor about the size of a clenched fist. It was very tender to the touch and gave the impression of being fixed to the abdominal wall and underlying structures. By careful palpation it was thought that fluctuation could be detected. The pelvis was investigated by a finger introduced into the rectum. It seemed to be filled up with a soft tender mass.

Operation, September 24, 1914, ether anæsthesia, iodine technic, exploratory laparotomy, drainage, died.

The patient when taken to the operating room was in bad condition and a hurried operation was in order, so the abdomen was entered through a left rectus incision centering on the umbilicus. On opening the peritoneum there escaped a quantity of foul-smelling pus. By now the man was in such poor condition that it was deemed inadvisable to make a further search for the lesion at the base of the trouble, so a liberal supply of drainage tubes were placed in the pelvis and the upper abdomen and after placing a few sutures in the superficial tissues the patient returned to the ward. He failed to rally, however, and died at 2 A.M., September 29, 1914, of toxæmia and generalized peritonitis, complicating a perforated gastric ulcer, as determined by partial autopsy.

CASE VIII.—C. G., white, male, aged twenty-nine, patternmaker, entered the hospital, October 27, 1914, at 3 P.M., with the complaint of pain in the stomach. With the exception of several mild attacks of indigestion within the past two years, his past history was of no especial interest. These attacks gave very little trouble and no attention was paid to them. His last attack began October 27, 1914. About 11 A.M., while he was at work, he was taken suddenly with such violent and severe pain in the abdomen that he was compelled to quit work. He went home and called in a physician. All the while the pain persisted. He was nauseated and vomited once. Showing no signs of improving, the physician brought him to the hospital. On admission the patient still had pain, but it had subsided somewhat from the administration of a hypodermic of morphia. Examination revealed very tense recti muscles and tenderness over the entire abdomen, but these symptoms were most pronounced in the upper abdomen. The mouth temperature was 100 degrees F., pulse 105. Immediate operation was advised and accepted.

Operation, October 27, 1914, ether anæsthesia, iodine technic, gastrorrhaphy and posterior gastroenterostomy, recovered. The abdominal cavity was entered through an upper right rectus incision. Upon opening the peritoneum, a large quantity of yellowish-white fluid escaped which gave rise to the suspicion of a perforated gastric ulcer as the cause of the gastric crisis. On delivering the stomach a small ulcer which had perforated was found in the anterior wall of the stomach close to the pylorus. This was closed with a purse-string suture of silk and the suture line covered with a piece of omentum. As this procedure caused a constriction of the pylorus, a posterior gastroenterostomy was done. A small incision was made through the abdominal wall just above the pubes through which tube drainage was inserted into the pelvis. The first incision was then closed and the patient returned to his bed in good condition. The convalescence was smooth, uneventful, and uninterrupted, and the man was discharged November 19, 1914, as cured. He was eating ordinary food with the greatest relish and the wounds were entirely healed.

Case IX.—This patient was a young white man, aged twenty-three years. He was brought to the hospital by his physician and gave the history of having been seized suddenly on October 28, 1914, with a boring pain in the upper part of the abdomen. On examination the abdomen was tense, rigid and very tender in the upper part. His pain was intense and his physician stated that he had given repeated doses of morphia which was pushed to tolerance, yet the pain persisted. On admission the patient's temperature was 99⅘, pulse 95, and respiration 20. The leucocyte count was 15,600. He gave a history of having suffered from repeated attacks of indigestion, with pain, gas, sour stomach and belching. He stated he had suffered thus for some years, exactly how long he could not say. He had continued to grow worse until the crisis came.

Impression.—Perforated gastric ulcer.

Operation, October 28, 1914, ether anæsthesia, iodine technic, gastrorrhaphy and posterior gastroenterostomy, recovered. The abdomen was opened by a right rectus incision extending from the costal margin to a point on the level with the umbilicus. When the peritoneum was opened, it was discovered that a generalized peritonitis had already set in. There was a quantity of bile-tinged serous fluid between the coils of the intestines. The stomach was brought into view and a large perforated ulcer was detected at the pylorus. An effort was made to close the hole with a suture but the tissue was so necrotic it would not hold. A piece of omentum large enough to cover the hole was cut off with which the rent was sealed. After closing the opening the posterior wall of the stomach was exposed and a gastroenterostomy made. Free drainage both of the pelvis and the general abdominal cavity was provided, the wound closed to the drains and the patient returned to his bed in poor condition. He remained unconscious and delirious in spells for four days, when he began to improve. On November 14th, he was permitted the use of a wheel chair. He was discharged November 24, 1914, his drain tract had closed, his appetite was good, his bowels regular, temperature and pulse normal. He was pronounced cured.

Case X.—P. C. V. D., white, male, seaman, aged twenty-one, entered the hospital March 30, 1915, at 2 P.M., with the complaint of pain in the stomach. The trouble began while at work, the afternoon of the day before, with sudden, violent cramplike pains throughout the entire abdomen. The pain was so severe that the patient was compelled to stop work and had to be carried to a cabin, at which time he was given castor oil. The treatment did not give relief, so the day following upon arriving in port, he was transferred to the hospital. At that time he was still complaining of pain, but it had somewhat ameliorated, nevertheless he appeared to be growing more ill. For the past two years he had had intermittent attacks of abdominal pain and indigestion. He was in a

hospital about six months ago, when a diagnosis of gastric ulcer was made. The man was markedly emaciated, the cheeks were flushed, the face bore an anxious expression and the pulse was rapid and feeble. Although there was no tympanites, the abdomen exhibited marked muscular rigidity and tenderness throughout its entire extent, especially was this true of the right side about the umbilical level. The mouth temperature was 100 degrees F., the rectal 102. A serious abdominal crisis was recognized and immediate operation advised and accepted.

Operation, April 3, 1915, ether anæsthesia, iodine technic, gastrorrhaphy, recovery. An incision was made over the right rectus muscle. Upon opening the peritoneum a great quantity of whitish, flaky fluid was found free in the abdominal cavity. The appendix was located and found to be normal. In traversing toward the stomach the intestines were found to be covered with fibrin, and upon delivering the stomach a perforated ulcer was found on its greater curvature situated about one and a half inches from the pylorus. This was closed with a purse-string suture of silk and the suture covered with a small piece of omentum. There did not appear to be any obstruction to the pyloric orifice, so a gastroenterostomy was not considered advisable. Rubber tube drains were placed in the pelvis, along with cigarette drains in other portions of the abdomen, and the wound closed about the drains. The patient made an uninterrupted recovery. The wound with the exception of the drainage tract healed by first intention, and the man was discharged on May 24, 1915, as cured, having gained weight, with normal digestion and eating regular food.

Case XI.—M. P., white, female, married, aged forty-seven years, entered the hospital the evening of September 7, 1915, with the complaint of persisting vomiting. She said she would vomit food she had eaten three or four days previously, for which ailment she had been treated by several physicians who pronounced the trouble indigestion. She had lost weight constantly during the year immediately preceding her illness, but more rapidly the last two months. The abdomen was of the scaphoid type. No masses could be felt. There was only slight tenderness above the umbilicus. X-ray examination demonstrated a huge stomach and a complete arrest of food at the pylorus, no bismuth showing in the small intestine after twelve hours. Gastric analysis showed a low hydrochloric acid content, a large quantity of yeast cells and decomposition products. Impression: Complete pyloric obstruction, gastric ulcer.

Operation, September 9, 1915, nitrous oxid ether anæsthesia, iodine technic, pylorectomy and posterior gastroenterostomy, recovered. A right rectus incision was made extending from the costal margin to below the umbilicus. The pylorus was found to be very thick with an obliterated lumen. The gall-bladder was plastered to the posterior wall of the pylorus. This was separated, exposing an old ulcer which had perforated. The whole pyloric area was thick and hard, but no glands were palpable. After tying off the blood supply to the pyloric end of the stomach and that to the proximal end of the duodenum, the ulcer-bearing area was resected, the ends of the stumps cauterized and turned in by Lembert sutures. A posterior gastroenterostomy was then done, drainage instituted and the wound closed down to the drains. The patient was returned to her room in good condition. After operation she experienced no pain nor difficulty with her stomach. Her appetite was excellent and nothing seemed to disagree with her. She was discharged September 28, 1915. At that time her wound had ceased draining and was almost closed.

Case XII.—F. D., white, male, thirty-five years of age, laborer, came to the hospital, November 22, 1915, with the complaint of pain in the lower abdomen. He stated he had had abdominal pain for two or three weeks. It was diffuse and was not very severe or prostrating. There was very little fever, but some nausea and vomiting. The pain gradually localized in the right iliac fossa. He gave no

history of any pain after eating, nor of gastro-intestinal disturbances of any standing. However, the man had been feeling badly for some time and complained of loss of appetite. Otherwise the history was of no interest. Other than a tender, tympanitic abdomen which was distended and painful, nothing abnormal could be found. The seat of maximum intensity of the pain was in the lower right abdomen. There was no fever or acceleration of pulse. The belly was quite hard, and muscle spasm rather noticeable in the right side. The white blood-cell count was 18,900.

Operation, November 23, 1915, ether anæsthesia, iodine technic, enterorrhaphy, cured. When the abdomen was opened through a right rectus incision, some free pus was seen between the coils of the intestines and a plastic exudate on their anterior surface. The appendix was delivered and found not sufficiently diseased to account for the severe peritonitis, so the incision was lengthened upwards. Now the stomach and duodenum were visible and were seen to be covered with a thick mass of omentum which was bound intimately to these structures, especially in the neighborhood of the pylorus. The omentum was divided and stripped from the surface of the gut, exposing about 2 cm. from the pylorus a perforated ulcer, from the opening of which gas and bile were escaping. The aperture was closed with a purse-string suture and a piece of omentum was stitched over the suture line. Drains were inserted in the neighborhood of the liver and in the pelvis. The soft tissues were closed down to the drains and the patient returned to his room in good condition. For the first few days after the operation there was a slight rise in temperature, pulse and respiration, otherwise the convalescence was smooth and the man was discharged January 1, 1916, with the wound completely closed. He was considered cured.

Case XIII.—G. H., white, male, shoemaker, aged forty-three, single, entered the hospital January 5, 1916, on account of pain in the abdomen. He stated that while at work the morning of the day of admission, he was suddenly taken with violent pain in the abdomen, which did not subside as the day wore on, but became progressively worse, necessitating him seeking the hospital for relief. After the onset of the trouble he was nauseated and vomited, but prior to the seizure was feeling perfectly well. His appearance was that of a very ill man. His face was anxious and pinched. Marked muscular rigidity was present throughout the entire abdomen, likewise tenderness, but more prominently in the upper right segment. The abdominal wall was so rigid that no tumor masses could be felt. The pulse was rapid and suggestive of a severe crisis. The mouth temperature was 97 degrees F., rectal 100. He denied ever having had lues or gonorrhœa. Suspecting a perforated gastric ulcer, operation was advised but declined. About three hours after admission the man's condition had become critical, operation was again suggested, and this time accepted.

Operation, January 6, 1916, ether anæsthesia, iodine technic, gastrorrhaphy, recovered. The abdominal cavity was reached through a right rectus incision centering on the umbilicus. Upon opening the peritoneum a large quantity of brownish, flaky material escaped which immediately drew attention to rupture in the upper alimentary tract. So a search was instituted for a hole in the stomach. This investigation was rewarded by the discovery of a rent about the size of a pea in the greater curvature of the stomach close to the pylorus. The hole was encircled by a purse-string of silk and closed. In order to further secure against the possibility of leakage a second row of suturing was made use of and a piece of the lesser omentum tacked over the suture line. Tube drainage was introduced into both the right renal and pelvic fossæ as well as to the site of injury and the wound closed down to the drains. The patient was returned to the ward in fair condition. From that time until March 11, 1916, when he was discharged, convalescence was uninterrupted.

CASE XIV.—E. P. C., white, male, aged fifty-five, stationary engine fireman, was admitted to the hospital January 17, 1917, with the complaint of severe intra-abdominal pain. He was exhausted and gave the following history: For some years he had been a sufferer from indigestion. He had had marked gastro-intestinal disturbances with much discomfort in the upper abdomen. Early in the morning of the day of entrance the patient had a sharp attack of pain in the midline of the upper abdomen. The pain was prostrating and the man was extremely shocked from the onset of the attack. On admission he was in bad shape, expression listless, tongue dry, skin pallid, pulse poor, and he was bathed in a cold perspiration.

Operation, January 17, 1917, ether anæsthesia, iodine technic, exploratory laparotomy, died on the table. A midline incision was made through the upper abdomen. This permitted the escape of about 500 c.c. of a flaky, greenish pus. The viscera were extremely congested. During the exploration the man became more and more feeble and died on the table. Examination of the stomach showed a large, punched-out ulcer about the size of a half dollar, with a perforated base about the size of a quarter. The abdominal cavity was full of a purulent material.

CASE XV.—J. W., white, male, aged thirty-four years, painter, was admitted to the hospital February 25, 1917, with the complaint of acute abdominal pain. There was no history of previous gastric trouble. The attack was sudden in onset and from the beginning was so sharp as to double the patient up like a jack-knife. The illness began at 5.30 P.M., February 24th.

Operation, February 25, 1917, ether anæsthesia, iodine technic, enterorrhaphy, died. The abdomen was opened through the midline below the umbilicus and two cigarette drains and one rubber tube inserted into the pelvic basin. This wound was then closed with the exception of the aperture for the drains and another opening made through the right rectus below the costal border. Exposure of the duodenum revealed a small perforation just distal to the pylorus. This was closed with several interrupted silk sutures, the abdominal cavity washed out with hot salt solution and the wound closed with the exception of the tract left for drainage purposes, three cigarette drains to the site of rupture. The man was returned to bed badly shocked and died the same evening.

Autopsy: Duodenal ulcer, generalized peritonitis.

CASE XVI.—A. H., white, male, aged thirty, engineer, was admitted to the hospital April 20, 1917, with the complaint of severe pain in the abdomen which came on suddenly twenty-four hours previously while eating. It started first in the epigastrium, just to the right of the midline and gradually extended over the entire abdomen. During the three years preceding he had had stomach trouble, as manifested by pain about one hour after eating. This was relieved by bicarbonate of soda. Examination showed a considerably shocked man with a rapid, thready pulse and exquisitely tender abdomen, with boardlike hardness on palpation. The white cells were 36,000.

Operation, April 20, 1917, gas and ether anæsthesia, iodine technic, enterorrhaphy, died. On opening the peritoneum through a right rectus incision a quantity of gastric contents escaped. With much difficulty the opening was found on the anterior surface of the duodenum, about three inches from the pylorus. It was about an eighth of an inch in diameter. It was closed by Lembert sutures and reinforced by a second line of suturing. Drainage was obtained by three cigarette wicks and two tubes to the site of the perforation and two tubes and two cigarette tucks to the pelvic basin. The wound in the soft parts was closed down to the drains. The patient was returned to the ward badly shocked. He did well for a few days, after which he took a turn for the worse and steadily lost ground until death, April 26, 1917.

CASE XVII.—L. S., white, male, aged thirty-two, machinist, U. S. Navy, was admitted to the hospital November 23, 1917, with the complaint of pain in the upper abdomen. About five years previously he had had his appendix removed. Before and since that operation he had suffered with indigestion. On one occasion he had had a hemorrhage from the stomach for which he was kept in bed two months. On the morning of November 23, 1917, while walking in the street the patient was taken with a sudden and sharp pain in the epigastrium. The pain was so sharp the man could hardly get his breath. As time wore on there was no improvement, so the patient was brought to the hospital. On admission, a few hours after the onset of the illness, he was very pale, his expression was drawn and pinched, he was complaining bitterly of severe pain in the abdomen and begged for relief. His thighs were flexed on the abdomen and could not be straightened out. The entire abdomen was rigid and so tender the man resented the slightest touch. The rigidity and tenderness were most marked on the right side and in the epigastrium. The clinical impression was gastric or duodenal ulcer with perforation.

Operation, November 23, 1917, ether anæsthesia, iodine technic, enterorrhaphy and posterior gastroenterostomy, died. The patient was under operation within two hours after the onset of his attack, and under the circumstances should have been an excellent risk. A right rectus incision was made. On opening the peritoneum, a quantity of purulent material, mixed with small particles of what appeared to be undigested food, escaped. An ulcer about 2 cm. in diameter was found to have perforated through the anterior surface of the duodenum about one inch below the pylorus. The opening was closed with mattress sutures of silk and a posterior gastroenterostomy made. Drainage of the pelvis was obtained by two rubber tubes, one through a stab wound above the pubes, another by way of the lower end of the incision. Four cigarette drains were introduced into the upper abdomen. The soft tissues were closed down to the drains. Twenty-four hours after the operation the patient developed a broncho-pneumonia in the left lung. His condition became gradually more critical and he died November 26, 1917, from œdema of the lungs. White blood-cell count, November 23, 1917, 26,000; white blood-cell count, November 26, 1917, 9000.

CASE XVIII.—W. F. F., white, male, farmer, aged thirty-six, was admitted to the hospital February 12, 1918, with the complaint of severe abdominal pain. This was during the war period and the history is very meagre.

Operation, February 12, 1918, ether anæsthesia, iodine technic, enterorrhaphy, died. This man was operated upon at 10.30 P.M., and returned to his room at 12.10 A.M. He left the table in a very critical condition, did not rally, and died at 1.55 A.M., February 13, 1918, of generalized peritonitis superinduced by a perforated duodenal ulcer which was sutured.

CASE XIX.—M. F., white, male, aged twenty-nine, laborer, came to the hospital May 5, 1918, with the following history: He stated about eleven o'clock last night he was taken suddenly with violent pain in the upper abdomen, especially around the umbilicus. He broke out in a profuse sweat and vomited some watery substance. He entered the hospital about fourteen hours after the onset of the attack. At that time he was very ill, and complained of intense pain in the abdomen, whose wall was very hard and board-like. He was tender over the entire abdomen, but this was accentuated over the upper right quadrant. He said he had suffered from indigestion all his life but had not been sick the day he was taken ill. The apices of both lungs were the seat of tubercular infection. The man was cachectic looking. A preoperative diagnosis of ruptured gastric or duodenal ulcer was made, and operation advised. The leucocyte count was 13,500.

Operation, May 5, 1918, gas and ether anæsthesia, iodine technic, enterorrhaphy, cured. A right rectus incision centering above McBurney's point was

made. When the peritoneum was opened the abdominal cavity was found filled with a turbid, flocculent fluid. The intestines were red and in the upper abdomen covered with lymph. There was considerable fluid between the liver and the diaphragm. After much difficulty a small opening was found in the duodenum, located on its anterior surface and in close proximity to the pylorus. This was closed with silk sutures, but owing to the friability of the intestinal wall the sutures cut out repeatedly. With persistence the opening was closed securely. A gastroenterostomy was not done. The abdominal cavity was flushed with hot sterile water. A rubber tube and three cigarette wicks were inserted above the stomach and between the stomach and liver. A hand was then passed into the pelvis and a small incision was made above the pubes and one rubber tube and three gauze tucks introduced to the bottom of the pelvic pouch. The upper wound was closed, save where the drains emerged. On May 14, 1918, the wound began to discharge a yellowish fluid. This was apparently from the duodenum. With the exception of this setback the patient made a smooth and uninterrupted recovery and left the hospital August 4, 1918, with the drainage tract about closed and discharging no fluid.

Case XX.—F. S., white, male, carpenter, aged fifty-three, was admitted October 23, 1918, with the complaint of excruciating pain in the abdomen. For years he had suffered with what he had supposed were attacks of indigestion. He had had pains in the abdomen which came on several hours after eating. Occasionally these pains were relieved by the ingestion of food or even water. The present attack began about six o'clock in the evening, October 23rd, while the man was on his way from his place of work, Camp Meade, to Baltimore. The abdomen was of a boardlike hardness and any attempt at palpation was bitterly resented by the patient. He had not vomited. The leucocyte count was 12,200, polymorphonuclears 70, lymphos. 28, eosinophiles 2 per cent.

Operation, October 23, 1918, ether anæsthesia, iodine technic, enterorrhaphy and posterior gastroenterostomy, recovered. The abdomen was entered through a high right rectus incision. Upon opening the peritoneum a large quantity of flaky material escaped. Inspection of the pylorus showed a perforated ulcer in the anterior wall of the duodenum. This was closed by mattress sutures and a posterior long loop gastroenterostomy done. A stab wound was made in the lower abdomen through which a rubber tube and several cigarette drains were inserted into the pelvic basin. A rubber tube and three cigarette tucks were placed through the upper wound to the neighborhood of the perforation, and the opening otherwise closed. The patient was returned to his bed in fair condition. The postoperative course was uneventful. There was no rise in temperature and no gastrointestinal disturbances worthy of mention. He was discharged November 18, 1918, cured.

Case XXI.—J. D. S., white, male, foreman, aged thirty-seven, was admitted to the hospital November 16, 1918, through the accident room, with the complaint of severe pain in the belly. He gave a typical ulcer history of several years' duration, periodicity of pain in the upper abdomen, relieved by the ingestion of food, the interval between attacks gradually becoming shorter until finally he was scarcely ever free from abdominal discomfort. He stated the present attack began several days before he sought attention at the hospital. The pain was very intense and but slightly influenced by opiates. He was much shocked and in a desperate condition. The abdomen was quite distended throughout and was very tender. The recti muscles were extremely rigid. The malady was diagnosed perforated gastric or duodenal ulcer and immediate operation advised.

Operation, November 16, 1918, ether anæsthesia, iodine technic, enterorrhaphy, died. A right rectus incision was made. When the peritoneum was opened a quantity of stomach contents escaped. Search revealed a perforated ulcer through

the anterior surface of the duodenum. This was closed by a purse-string suture and the line of suture reinforced by an omental graft. For drainage purposes tubes were inserted into the pelvis, renal fossæ and the lesser peritoneal cavity. The patient failed to rally after the operation. His condition became gradually worse and he died at 12.45 P.M., November 18, 1918, as a consequence of a generalized peritonitis due to a perforated duodenal ulcer.

CASE XXII.—J. A. C., white, male, of Virginia, aged fifty-four, farmer, married, was admitted to the hospital June 4, 1919, for stomach complaint. For the past year he had been having indigestion with attacks of pain in the epigastrium, but did not vomit, nor did he give history of the presence of any blood in the stools. The pain was either before or after meals and occurred with no reference to periodicity or regularity. About two weeks previous to admission the indigestion became more pronounced and he had several attacks of vomiting. At this time he noticed that the stools were black. Two days before admission he was suddenly seized with sharp pain in the epigastrium. He felt something break inside. Following this catastrophe he passed blood per rectum. Muscular rigidity extended over the entire abdomen, but was especially marked in the right hypochondriac. There was no evidence of jaundice.

Operation, June 4, 1919, ether anæsthesia, iodine technic, enterorrhaphy and appendectomy, died. The abdominal cavity was reached through a right rectus incision. After getting into the peritoneal cavity investigation revealed an ulcer which had perforated through the anterior wall of the duodenum. It was situated but a short distance from the pylorus. The appendix was found to be the seat of a chronic inflammation. The rent in the duodenum was closed with a purse-string suture and the appendix removed, and tube drainage instituted. The day following the operation the temperature and pulse began to flare up and the patient complained of nausea but did not vomit. By June 9th the condition had become progressively worse, the pulse dicrotic and weak and the patient expired June 13, 1919.

CASE XXIII.—W. G., white, male, aged sixty-five, came to the hospital February 12, 1920. His first complaint was acid stomach in spells. This started three years ago. These attacks finally became more frequent and annoying, necessitating for their relief food or bicarbonate of soda. Of late he has been compelled to take food to bed for consumption in the middle of the night. However, the trouble did not materially interfere with his comfort until about ten days before admission to the hospital, when he was seized with an acute exacerbation of pain and had been having unendurable pain ever since. He had vomited on occasion, but had never noticed any blood in the vomitus. On admission examination of the abdomen showed it to be markedly distended, especially in the upper quadrants. The liver dullness had entirely disappeared. The muscles of the upper abdomen were rigid and the epigastrium and right upper quadrant were exquisitely tender to pressure. He complained of spasmodic pain in this region. On February 15th he became worse. The pain was more intense and he vomited. Although the X-ray examination suggested an old pneumothorax of the right lower chest, the clinical signs seemed to indicate an ulcer of the stomach or duodenum, consequently the clinical impression was rendered ulcer of the stomach or duodenum, probably perforated and shut off. An operation was recommended as the only hope of preserving life. It was accepted.

Operation, February 16, 1920, gas and ether anæsthesia, iodine technic, gastrorrhaphy and posterior gastroenterostomy, died. The abdomen was entered through a right rectus incision; when the peritoneum was opened the liver was found adherent to the parietes. Upon liberation of these structures a quantity of gas with colon bacillus odor escaped. The stomach was bound down to the surrounding structures by many adhesions. When these were separated suffi-

ciently to permit delivery of the stomach a small perforation was detected in its anterior wall near the lesser curvature. This was closed with two rows of sutures followed by a posterior gastroenterostomy. The patient stood up well under the operation. Following the operation, however, there was much drainage from the wound, elevation of temperature, quickening of pulse, but no vomiting or pain. This condition increased and he died February 18, 1920, apparently from general sepsis. At autopsy there was no peritonitis, but the sutures had failed to hold and there was leakage from the stomach.

Case XXIV.—J. G., white, male, aged twenty-two, married, entered the hospital April 12, 1920, with the complaint of sharp, excruciating pain in the epigastric region which caused him to double up like a jack-knife and he was unable to straighten out. The patient had been troubled with indigestion for the past three years and frequently had pain one-half hour after eating, from which he obtained relief by vomiting. He had never noticed any blood in the vomitus, nor in the stools. The abdomen was extremely rigid throughout, but more marked in the epigastrium. This region was also very tender to pressure. Clinical impression: Ruptured gastric or duodenal ulcer.

Operation, April 12, 1920, ether anæsthesia, iodine technic, gastrorrhaphy and posterior gastroenterostomy, cured. The damaged organ was reached through a high right rectus incision. On examining the stomach a hole was found in its anterior wall in the neighborhood of the pylorus. This was sutured and the line of suturing capped with an omental graft followed by a posterior gastroenterostomy. The pelvis was drained through a stab wound above the pubes and the upper abdomen through the original incision. The man made a very smooth recovery and was discharged April 26, 1920, cured.

Case XXV.—J. C., white, male, aged fifty-three, laborer, married, was admitted to the hospital October 25, 1920, through the dispensary, for stomach complaint of ten years' duration. The trouble began as a small area of localized pain in the epigastrium, coming and going at intervals. About six years ago the pain became more diffuse, spreading all over the abdomen. Eating was followed by much gastric distress and pain. The pain during the latter part of the illness was more or less constant, varying in intensity and greatly aggravated about three hours after eating. By vomiting alone could he obtain relief. The vomitus was greenish at times, and on other occasions yellowish or chocolate colored. It varied in amount from a quart to a half gallon. He never noticed any blood in the vomited matter. He stated the vomitus contained very little food particles. About five weeks previous to entrance into the hospital he noticed a small amount of blood in the stool. The pain was sharp, began in the epigastrium and radiated upward into the thorax and backward to the back. It was accentuated at night and when it was at its worst gave him the sensation of knots in both sides of the abdomen. At the time of admission the abdomen was slightly distended, but no masses could be detected. The history of this case was most suggestive of ulcer at the pyloric region. Other physical examination, save for evidence of underweight and undernutrition, slight rigidity of the recti, especially above, and a moderate amount of tenderness to the right of the midline in the epigastrium, was without note. The Röntgenological examination showed: (1) Gastric dilatation; (2) blunt end at pylorus; (3) no filling defect; (4) cap not visible; (5) duodenum does not fill; (6) lack of normal emptying power of the stomach (gastric stasis, twenty-four hours). The laboratory findings were without note. Clinical impression: Pyloric obstruction due to pyloric ulcer.

Operation, November 10, 1920, ether anæsthesia, iodine technic, posterior gastroenterostomy, died. The stomach was exposed through a right rectus incision. There seemed to be a mass around the pylorus which was taken for a carcinoma, especially as the mesenteric glands were enlarged, so a posterior

gastroenterostomy was done and the abdomen closed. From the day of operation to November 11, 1920, the patient failed slowly but steadily, on which date he died.

Autopsy: A complete necropsy was done, but the only findings of interest were: The peritoneal cavity, especially on the right side, contained a fair amount of free pus which was yellowish and blood tinged. The loops of intestines had a tendency to adhere to each other, but could be readily separated. The gastroenterostomy hole was healthy and there was no evidence of any leakage. There was no thickening nor tumor mass in the region of the pylorus, but one inch from the pylorus in the duodenum there was an ulcer 30 mm. long with indurated edges. It was rather sinuous in outline and extended through all the coats including the peritoneal, leaving an opening 8 mm. in diameter. Its edges were not rough. This perforation was on the under surface in close proximity to the head of the pancreas. There were some adhesions in this region which were fairly well organized. The duodenum as well as the small and large intestines contain free and clotted blood.

Anatomical diagnosis: Perforating duodenal ulcer with hemorrhage and acute diffuse peritonitis. Cultures made from the pus showed colon and other intestinal organisms.

Microscopical diagnosis: Perforated duodenal ulcer with carcinomatous changes. Chronic diffuse pancreatitis; pancreatic area beneath ulcer showed infiltration with carcinomatous cells.

Stomach analysis: Free HCl, 34; comb. HCl, 12; organ acids and acid salts, 8. Total, 54.

Stool negative for occult blood. Blood type group IV. Hæmoglobin, 75 per cent.; red blood-cell count, 5,400,000; white blood-cell count, 4500; polymorponuclears, 58; small lympocytes, 35; large mononuclears, 6; eosinophiles, 1 per cent.

Case XXVI.—R. G., colored, male, married, laborer, aged forty-four, was admitted to the hospital December 27, 1920, with the following history: About twelve hours ago he was taken suddenly ill with abdominal pain which produced great shock. The trouble began two years ago with pain in the stomach which was treated for indigestion. The pain was knife-like and occurred about one-half hour after eating. It continued to get worse until relieved by the next meal. During the past year the pain was more or less constant, but was much worse on an empty stomach and somewhat relieved by food. Its point of greatest intensity was just below the ensiform cartilage, but on occasion involved the whole abdomen. He was never nauseated nor did he vomit, but he did suffer from some heartburn. He was very constipated and would go four or five days without a passage. He had never noticed any tarry stools. He had worked steadily up to the time of being taken seriously ill. Entrance examination showed a markedly distended abdomen which was exquisitely tender. He complained continuously and bitterly of severe pain. The pulse was fast, the temperature elevated, and the facial expression anxious. The white-cell count was 10,000, the differential picture, polynuclears 84, small mononuclears 14, large mononuclears 2 per cent. Impression: Perforated gastric or duodenal ulcer, peritonitis.

Operation, December 27, 1920, ether anæsthesia, iodine technic, gastrorrhaphy, followed by subphrenic abscess, died. After opening the peritoneum through a right rectus incision search revealed a perforated ulcer in the anterior wall of the stomach near the pylorus. This was sutured and five cigarette tucks and one tube used above and three cigarette wicks and one tube in the pelvis for drainage. The patient did very well until January 29, 1921, when his temperature which had been normal for some days jumped up to 102 degrees F., pulse 120, respirations 30, from then until February 16, 1921, he ran a low-grade fever. About this

time suspicions of a subphrenic abscess arose. These suspicions were confirmed by X-ray examination and aspiration. On February 17th, an incision was made in the tenth intercostal interspace and a quantity of pus evacuated from between the liver and the diaphragm. The patient failed to rally, however, and died on February 22, 1921.

CASE XXVII.—G. B., white, male, fifty-eight years old, blacksmith, something less than a year ago had the left leg amputated in this hospital for an old fracture-dislocation at the ankle. He made an uneventful recovery and with the use of an artificial leg had been for some time following his trade. Around 5.30 in the afternoon of February 27, 1921, he had a sudden seizure of severe agony in the diaphragmatic region. He was not sure whether the pain was in the upper abdomen or lower chest. The pain was very severe and he went into immediate collapse. When seen about three hours after the onset of the attack he was complaining chiefly of pain in the chest and embarrassment of respiration. His abdomen was rigid and he was in a state of shock. Soon thereafter improvement set in. He was, however, sent to the hospital for observation as there was doubt as to the diagnosis. There he was seen by a number of men on the staff and the following diagnoses were considered: (1) Perforated gastric or duodenal ulcer; (2) mesenteric thrombosis; (3) ruptured aneurism; (4) acute pancreatitis. Immediately after admission to the hospital the man's condition continued to improve. His abdomen became soft, pulse better, temperature normal. The leucocyte count was 17,000. Later in the day his abdomen became stiff and it was believed that he had a perforated gastric ulcer and immediate operation was advised.

Operation, February 27, 1921, ether anæsthesia, iodine technic, enterorrhaphy, later subphrenic abscess, died. The abdomen was opened by an upper right rectus incision and a perforated duodenal ulcer found immediately beyond the pylorus in the anterior wall of the gut. The opening was closed and the abdomen and pelvis drained by two cigarette wicks and two tubes. On March 18, 1921, the man was taken suddenly worse, the pulse became weak and the patient complained of pain in the upper left abdominal quadrant. He was therefore aspirated through the eighth left interspace immediately beneath the angle of the scapula and a black pungent fluid withdrawn. He was too ill to be X-rayed. This was supposed to be a left subphrenic abscess or an infarct of the lung. The patient failed to rally and died at 8 P.M., March 24, 1921.

Autopsy, March 25, 1921: Other than the following the findings were of no interest. The stomach was normal, the pylorus patent. Immediately beyond the pylorus was a small punched-out ulcer in the anterior wall of the duodenum. The covering immediately over the ulcer showed the silk sutures put in at operation. There had been no leakage. The intestines were shiny and glistening everywhere. A large abscess was found beneath the diaphragm on the left side. It was bounded below by the cardiac end of the stomach and the spleen. The abscess communicated with the lesser peritoneal cavity which in turn communicated with the drainage tract.

CASE XXVIII.—C. W., white male, aged thirty-nine, laborer, entered the hospital the night of April 3, 1921, on account of excruciating pain in the upper left abdominal quadrant. During the preceding sixteen months he had been suffering with indigestion and pain in the abdomen which came on half an hour after eating. This pain was relieved by more food or bicarbonate of soda. He was nauseated and vomited at times. He was seen two days previous to admission to the hospital and a provisional diagnosis of ulcer of the stomach made. He had been working as a wheelwright steadily and worked the day he sought entrance into the hospital. About 7 P.M., April 3, 1921, he became nauseated and in striving to vomit was seized with a sharp, stablike, agonizing pain in the upper

abdomen. He collapsed and would have fallen to the floor, had his wife not caught him. The pain radiated toward his heart. He was seen one-half hour after the onset of this attack. At that time he was in collapse and bathed in a profuse sweat. His skin was cold and clammy. The left thigh was flexed on the abdomen and he begged piteously for relief. His upper abdomen was slightly tender and rigid but within a very short space of time the rigidity extended to the entire abdomen. A diagnosis of perforated gastric ulcer was made, operation advised and accepted.

Operation, April 3, 1921, ether anæsthesia, iodine technic, gastrorrhaphy, pneumonia, died. The abdomen was approached by an upper right rectus incision. As the peritoneum was opened, there was a gush of gas and about one-half pint of bile-stained fluid was found in the peritoneal cavity. Further search revealed a perforation in the anterior wall of the stomach. It was three-eighths of an inch in diameter, situated in the lesser curvature, in close proximity to the cardiac orifice. The indurated area was one and one-half inches in diameter. The rent was closed by mattress sutures and capped by a piece of free omentum. A stab wound was made in the right loin beneath the liver and a tube inserted down to the kidney shelf. A second opening was made above the pubes for tube drainage of the pelvic basin. As additional safeguards tubes and cigarette tucks were placed in the upper abdomen through the right rectus incision. The patient was returned to his bed in fair condition. From operation until April 12, 1921, the man made satisfactory progress, but on that date developed a pneumonia in the right lower lobe and gradually sank until death April 14, 1921.

In this case the perforation occurred at 7 P.M., and the patient was on the operating table by 10 P.M. and off by 10.50 P.M., yet despite the early period he was gotten after rupture, he died. Before death all of the drains had been removed, the belly was soft and the bowels moving regularly. It serves well to illustrate the desperateness of the condition no matter how early after perforation the case is operated.

CASE XXIX.—W. W., white, male, aged twenty-nine, sailor, entered the hospital April 29, 1921. While engaged in painting the side of a ship which was lying in the harbor, about 10 A.M., the day of admission, he was seized with a severe pain in the abdomen. He suffered a chilly sensation and vomited. As the day wore on the pain increased in severity and vomiting continued. The pain at first was diffused throughout the abdomen, but soon localized in the epigastrium. The patient stated he had had a similar attack of less intensity two weeks previously. The pain at that time, however, only lasted a few hours and he was soon able to resume his customary work. He had suffered but little disturbance since that time. There was no history of gastro-intestinal disturbances antedating these attacks. The man stated he had never suffered from indigestion and could eat anything he pleased. He entered the hospital at 5 P.M., at which time he was suffering intensely and was severely shocked. In bed he lay upon his right side with knees flexed on the abdomen. He did not vomit after entrance. The temperature by rectum was 99⅘ degrees F., leucocyte count 24,000, pulse 80. He was operated upon at 7 P.M., at which time he had somewhat recovered from his shock. He denied luetic or Neisserian infection. In the first attack the man stated he both vomited and defecated blood. On admission his abdomen was boardlike and tender everywhere, especially in the epigastric region. Impression: Perforated duodenal ulcer.

Operation, April 29, 1921, ether anæsthesia, iodine technic, gastrorrhaphy, recovered. The abdomen was reached through a right rectus incision centring about the umbilicus. As soon as the peritoneum was opened a murky fluid escaped. This fluid contained shreds of yellowish fibrin. A round opening was found in the stomach immediately above the pylorus from which fluid was flowing

copiously. A purse-string suture of silk was thrown around the perforation and the aperture closed. Another layer of sutures was then inserted and over all a strip of omentum was tucked. Rubber tubes were placed in the right and left renal fossæ, two cigarette rolls over the suture and a large rubber tube introduced into the pelvic basin. The man stood the operation very well. The area around the ulcer was thick and œdematous which rendered suturing difficult, as there was a tendency for the sutures to cut out. After operation the patient made satisfactory progress. There was scarcely a ripple in the smoothness of his convalescence. He was discharged from the hospital June 10, 1921, cured.

PERSISTENCE OF GASTRIC ULCER AFTER GASTROENTEROSTOMY

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The surgical procedures that have been advocated and performed for the cure of gastric ulcer are:

1. Gastroenterostomy with or without pyloric exclusion.
2. Excision of the ulcer either by the knife or cautery.
3. Excision of the ulcer combined with gastroenterostomy.
4. Segmental or "sleeve" resection, either alone or combined with gastroenterostomy.
5. Partial gastrectomy.
6. Pyloroplasty with or without excision of the ulcer.

During recent years there has been an increasing tendency toward the performance of the more radical procedures. However, a large group still maintains that gastroenterostomy gives the best postoperative results. Professor Sherren,[1] in his Hunterian lecture, states that no definite rule can be laid down, but nevertheless leans decidedly toward gastroenterostomy. He says, for instance, "Gastroenterostomy is still the operation of choice in the majority of cases," and, "this (gastroenterostomy) will bring about permanent healing in free ulcers; those that have perforated and have an adherent base or floor formed, usually of liver or pancreas, do not completely heal after this procedure alone." Paterson[2] believes that when the operation is properly performed it is as satisfactory as any major surgical operation, and that the failures do not exceed 7 per cent. Coffey[3] very stoutly maintains that gastroenterostomy is "still the treatment for chronic gastric and duodenal ulcers." And others who lean strongly toward this procedure as the operation of choice are Metraux,[4] Zacherl and Landes,[5] Borchgrevink,[6] Kuttner,[7] Rowlands,[8] and Gallart and Ribas.[9]

The numerous failures following gastroenterostomy have, however, led to a far more insistent note of dissatisfaction. There is no doubt that when this operation is performed for gastric ulcer the following sequelæ may ensue:

1. Hemorrhage: This does not refer to immediate postoperative bleeding, but to late hemorrhage. Eggleston[10] tells of a patient who had two severe hemorrhages from the stomach before operation, and then in spite of a gastroenterostomy for the cure of his ulcer had three more. His series showed that in 11 per cent. of the cases subjected to operation hemorrhage occurred some months or years after the operation. (No tables are given, but he states that the operation usually performed was gastroenterostomy, and his series includes both gastric and duodenal ulcers.) Balfour[11] found

that in 8 per cent. of the patients who had had hemorrhages before operation the bleeding recurred, and in 3 per cent. of those who had no hemorrhage previous to surgical intervention it subsequently developed. Coffey,[3] a staunch advocate of gastroenterostomy, says "a few of the cases had severe hemorrhages several months or years after operation." Moynihan [12] also calls attention to the occurrence of late hemorrhage and reminds of the fatal cases that have been reported by Kocher, Quénu, and Eve. Zweig,[13] in a recent paper devoted to this subject, found that among seventeen patients in whom a gastroenterostomy had been performed for the treatment of bleeding peptic ulcer the hemorrhages persisted or recurred in fourteen. Seven of the latter were reoperated upon. In three the original ulcer was found unhealed, and in the other four a gastrojejunal ulcer had produced the bleeding. Zweig also mentions Von Petren's statistics where 7.4 per cent. of 203 gastroenterostomies had hemorrhages after operation, and Rovsing's tables, in which the percentage was 10 per cent.

2. Perforation of an unhealed ulcer: Monyihan,[12] Von Haberer [14] and Troell [15] each report fatal cases of perforation following gastroenterostomy that had been performed for ulcer. (Gastrojejunal ulcers are not included.)

3. Carcinomatous degeneration: It makes some difference whether we believe that 2 per cent. of ulcers degenerate into carcinomata or that 60 per cent. do so. Nevertheless, both views concede the possibility of such an occurrence, and render the ulcer a continuous potential danger. Further, one cannot always differentiate on the operating table between ulcer and carcinoma. In Von Haberer's [14] series five specimens that were believed to be typical ulcers at the time of the operation were under the microscope found to be carcinomata. The routine removal of all ulcers certainly gave these patients a better fighting chance than had the routine been merely to perform a gastroenterostomy; and the apparently benign gross appearance of the lesion would not have created a contraindication to the latter operation.

4. Persistence or recurrence of gastric symptoms: Some one has said, "Statistics may be made to prove anything, even the truth." Perhaps that accounts in part for the fact that Metraux [4] can report from Roux's service 90 per cent. cures following gastroenterostomy (only twenty-seven of the 210 cases were duodenal, the rest being pyloric and gastric ulcers), while on the other hand, Denéchau [16] could find only 20 per cent. of excellent results in fifty-one cases of gastric ulcer traced over a period of from four to twelve years. Human nature being prone to honest prejudices, comparative series of failures and successes—and enough of them can be adduced to favor either side—apparently prove very little. If on the other hand it is shown in enough cases that the persistent or recurrent symptoms are due to the serene unconcern of the ulcer in spite of a gastroenterostomy, such evidence will be of much more tangible value. It is true that some of the failures after this operation are due to technical errors. What the percentage is we do not know. Yet the suspicion is often aroused that what is attributed to an error in technic may in reality be due to the original ulcer. The occurrence of late

hemorrhage after gastroenterostomy certainly adds strength to such a view.

Direct evidence of the persistence of ulcers after gastroenterostomy is afforded by the cases reported by Von Haberer.[14] In his first case, a gastroenterostomy performed by von Eiselsberg, a subsequent pyloroplasty and gastroplasty, together with a jejunostomy, were all without effect on two large ulcers. (There is no mention of the size and fixity of these ulcers at the time of the first operation.) In the second case, a gastroenterostomy was done for an ulcer on the lesser curvature which was freely movable, and therefore according to Sherren a proper procedure. Nevertheless, a few months later at a second operation, the ulcer was found to have thrived so well that it had penetrated into the liver and pancreas. In a third case an ulcer on the lesser curvature and an ulcer at the pylorus persisted in spite of a gastroenterostomy with enteroanastomosis. These three cases were all cured by partial gastrectomy. Moynihan[17] also mentions the fact that in some of the cases which he reoperated the ulcer was still open and had usually perforated and become adherent to the liver.

Still more interesting are the cases where typical gastric ulcers developed in the very face of a gastroenterostomy. (Gastrojejunal and jejunal ulcers are not included.) Moynihan[18] tells of two patients in whom gastroenterostomies were performed where at the time of the operation the stomach was found normal, the gastroenterostomies presumably being done for duodenal ulcer. Typical gastric ulcers, well away from the line of the anastomosis, subsequently developed. Carter[19] reports that Moynihan later had a third case. Coffey[8] also had a patient in whom after a gastroenterostomy with pyloric exclusion an ulcer developed in the stomach distal to the anastomosis. Kotzareff and Balmer[20] describe a case where an ulcer developed on the lesser curvature. It hardly speaks well for this operation when the condition which it is meant to cure may sometimes develop in spite of the fact that it has already been performed.

Below is reported a case where an ulcer situated on the lesser curvature in the centre of the antrum persisted following a gastroenterostomy. Ulcers in the antrum and pylorus have been believed to yield especially well to gastroenterostomy.

Miss W., a private patient of Dr. A. A. Berg, with a negative past and family history, had been sick for six years previous to her admission to the hospital. She was seized with intense pain in the epigastrium coming on about two hours after meals. This pain was not relieved by taking food or soda, but ceased spontaneously after about an hour. She lost twenty pounds in weight. The pains were present for a few months and then were followed by a variable interval of several weeks or months in which she felt better. An X-ray taken in February, 1918, revealed the presence of a gastric ulcer. On March 13, 1918, a gastroenterostomy was performed by a surgeon of wide experience.

She was relieved of her symptoms only five weeks, when they all

returned with increasing severity. The pain, coming on about one or two hours after each meal, was especially severe. Nausea was present almost all day. There was no vomiting. Loss of weight continued until on her admission to the hospital she weighed eighty-five pounds. X-ray and fluoroscopic examinations performed by Dr. E. A. Aronson showed a normally situated stomach, marked hypermotility and exceedingly rapid evacuation through the stoma. There was no six-hour residue.

On June 8, 1919, Dr. A. A. Berg reoperated. The gastroenterostomy stoma was found to be about one and three-quarters inches long and was apparently functioning properly. There was no evidence of ulceration in any part of its circumference. The jejunum also was healthy. Exploration of the rest of the stomach revealed, however, the presence of an ulcer on the lesser curvature about one inch from the pylorus. The ulcer was perfectly free and not adherent to any of the neighboring organs. The gastroenterostomy stoma was proximal to this ulcer. A partial gastrectomy was then performed according to the Billroth II method, the antrum being removed up to a point proximal to the ulcer. The existing gastrojejunostomy was left intact. Further examination of the stomach and duodenum during this procedure did not show the presence of any other ulcer or the scar of a healed ulcer. The stomach and the first portion of the duodenum were examined interiorly as well as exteriorly.

This patient is now perfectly well one year after the operation. She has gained thirty pounds in weight, eats anything, and, in the words of Von Haberer, "is unconscious of the fact that she has a stomach."

Inasmuch as her symptoms returned five weeks after her first operation,—a well-performed gastroenterostomy,—and inasmuch as a very careful search failed to reveal the presence of a scar that would be left by a previously healed ulcer, it seems certain that she was suffering from this same ulcer at the time of her previous operation, and that the gastroenterostomy performed for its cure was entirely without effect. It should again be emphasized that this ulcer was near the pylorus and that it was not adherent to any of the neighboring organs.

There is no intention in this paper to discuss the relative merits of the other surgical procedures for the treatment of gastric ulcers. It is merely intended to add a little further evidence to the view that has steadily gained ground, that no matter what procedure is used, it should, if at all possible, include removal or destruction of the ulcer. That this view is, however, by no means generally accepted is shown by the number of distinguished men mentioned in the beginning of this paper who still lean most strongly to gastroenterostomy.

The most important argument advanced against the radical procedures, such as partial gastrectomy, is the higher mortality of this operation as compared to gastroenterostomy. But such an argument is really not fair. None but members of the extreme right wing will deny that a gastroenterostomy alone is of very little value in the treatment of, let us say, an ulcer on

the posterior wall, perforated and adherent to the pancreas. Here the ulcer must also be attacked, for instance by a partial gastrectomy (others will prefer excision), if a cure is to be predicted with reasonable frequency. It is therefore not fair to place the mortality rate of gastroenterostomy against that of gastrectomy. In a large number of severe cases which the latter operation cures the former is entirely without effect and might just as well not have been done. It would be almost as logical to compare the mortality rate of inguinal herniotomy with gastrectomy.

As regards the mortality of partial gastrectomy, there can be no doubt that with the improvement of technic it will be lowered. It may be interesting to add that when Von Hacker,[21] in 1895, reported concerning the gastroenterostomies that had been performed in Billroth's clinic from 1880 to 1894, there was a mortality of almost 51 per cent. To-day that figure has shrunk to from 2 to 4 per cent.

SUMMARY

1. Gastroenterostomy performed for the cure of gastric ulcer may be followed by—

a. Hemorrhage. In one-half of the cases this probably comes from the unhealed ulcer.

b. Perforation of an unhealed ulcer.

c. Carcinomatous degeneration of the ulcer.

d. Persistent or recurrent gastric symptoms. In some of the cases these symptoms are due to the unhealed ulcer.

2. Gastric ulcers may develop in the stomach in the presence of a gastroenterostomy. This does not refer to gastrojejunal ulcers.

3. A case is reported where the persistence of gastric symptoms was due to an unhealed prepyloric ulcer following a well-performed gastroenterostomy. The symptoms yielded to partial gastrectomy.

4. If at all possible the surgical treatment of peptic ulcer should include the removal or destruction of the ulcer.

5. It is unfair to compare mortality statistics of partial gastrectomy and gastroenterostomy, since the former operation can cure severe cases in which the latter is entirely without effect and might just as well not have been done.

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JEJUNAL DIVERTICULA

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The purpose of this communication is to place on record two cases of diverticulum of the upper third of the jejunum, in one of which the diagnosis was made by the X-ray and confirmed by operation wherein the diverticulum was removed with recovery of the patient and relief of symptoms, while in the other a diagnosis of appendicitis was made; a fatal result followed appendectomy and autopsy revealed a diverticulum.

Hitherto much has been written of diverticulosis of the colon and more recently of the duodenum. An article by William Mayo,[1] in 1917, covers the former, and articles by Case,[2] of Battle Creek, Roberts and Cole,[3] and E. Willys Andrews [4] within the past year cover the latter, so that a discussion of diverticulosis in general will not be attempted. It is because of the comparatively few cases on record of the particular lesion described, as well as the apparent fact that the condition comprises a clinical entity diagnosable and susceptible to specific relief by surgery, that we offer this report.

Referring briefly to Case's paper, we find that he was able to collect from the literature of the period 1854 to 1920 but seventeen cases in which diverticula of the jejunum were found at operation or autopsy. Of these four were single, and the rest multiple, one having four hundred sacculations. It is interesting to note that practically all are at or near the mesenteric attachment and when multiple may be associated with diverticula of other parts of the intestine and sometimes of the bladder.

To this list Case adds two detailed histories from his own experience, in both of which the diagnosis was made by X-ray and confirmed by operation. He also refers to three other diagnoses made, but which were not confirmed, as patients were not operated upon and therefore not included in his list. So far as we know, the honor of being the first to diagnose the condition prior to operation belongs to Case; we believe, however, that under the stimulation of his articles others like ourselves will find them out and one more "rare" condition will assume a position in the ranks of the relatively commonplace.

In support of our suggestion that the condition may be a clinical entity of some importance, we take the liberty to abstract the history of his first case, which was an adult male having a single large diverticulum near the duodeno-jejunal junction, in which the symptoms were "indigestion" for the preceding ten months, feeling of pressure and distention of stomach developing immediately after meals, causing much discomfort and distress, relieved

somewhat by belching of gas, no pain, no nausea and no vomiting, but occasional "heart-burn" at two A.M. and intestinal flatulence. This large sac was associated with many small ones and was situated between the folds of the mesentery and devoid of muscularis. Treatment was resection of 30 cm. of the bowel.

CASE I.—E. C., male, aged fifty-four. Occupation, operative. His work required considerable sustained muscular tension but no direct pressure on abdomen. Admitted medical, December 12, 1920. Service of Dr. G. A. Tripp. Chief complaint: Stomach trouble.

Past history negative up to present illness, which dates from fifteen months ago, since when he has lost fifty pounds in weight and feels "run down." His trouble began rather abruptly with epigastric pain, developing one morning after he had begun work and thereafter about ten minutes to one hour after meals, more recently as apt to come on with stomach empty and to be eased by taking food, but returning soon after. The pain is located in middle epigastrium and radiates to right and back. Patient is sure that he observed blood in stool a week ago, has no hemorrhoids, has never been nauseated nor has he vomited at any time.

Physical examination: Well-developed and nourished man in fair general condition.

Central nervous system, heart, lungs, skin, genitals and extremities normal.

Abdomen: relaxed, soft, tympanitic; no area of localized tenderness, except rather vaguely deep in middle epigastrium. By rectum: Prostate is found slightly enlarged, no tenderness, swelling, hemorrhoids or fissure felt. Temperature, 96.8°. Pulse, 94. Blood-pressure, 90/60. December 18, 100/76.

Urine: December 13, 1920, acid, 1034, no albumen, sugar or bile.

X-ray examination: (December 18th): Regular gastro-intestinal series. No abnormality shown in stomach or duodenum. In region of jejunum and shown on a series of plates is a shadow about size and shape of the duodenal cap. Diverticulum might produce such an appearance.—P. H. Cook.

Note.—Sac had nearly emptied on six-hour plate and entirely on twenty-four hour.

Progress: House diet with meat.

December 16th: Patient's gastric distress seems to be of an indefinite character, pain and distress may come on twenty to forty-five minutes after meals or in the evening on empty stomach. Still losing weight.

Blood chemistry December 22nd: Sugar, .11; creatinin, 1.1; urea nitrogen, 14; alkaline reserve, 65.

December 12th: Wassermann negative.

December 21st: Blood differential; polymorphonuclear, 76 per cent. Lymphocytes, 20 per cent. Eosinophiles, 3 per cent. Mast, 1 per cent. Reds show no abnormality; platelets present in average ratio to reds.

December 22nd: Whites, 7800; reds, 3,864,000.

December 15th and 18th: Examination of stools negative for blood. Phthalein test, December 16th, 58 per cent., two hours.

December 23rd: Urine, acid, 1032. No albumen; no sugar.

December 21st: X-ray examination repeated. Diverticulum shows as before, not visibilized by fluoroscope.—P. H. Cook.

December 24th: Transferred surgical. Operation December 29th.

Operation Record: Operator, Doctor Hunt; assistant, Doctor Baxley. Anæsthetic, ether; cone method, by Miss Fennell. Preoperative diagnosis: Diverticulum of jejunum (by X-ray department).

Description of operation: Right paramedian incision centering at level of umbilicus. Appendix pulled out and found to contain concretions and was removed. Systematic exploration of small intestine, beginning at ileocæcal junction and carried upward, found three inches below upper end of jejunum on the left side near the mesenteric attachment, a diverticulum roughly pear-shaped and approximately three cm. deep and three cm. broad. Dissecting peritoneum around its attachments, the communication with the intestine was found to be about 1 cm. in diameter. The diverticulum was clamped at the neck, tied off, amputated, and the stump buried by a double row of Lembert sutures, the mesentery on that side being hooked up by a large suture to serve as a buttress. This procedure was carried out with very careful protection of adjacent bowel by gauze. Wound closed layer by layer.

Condition of organs explored: Gall-bladder, duodenum, liver, stomach and colon normal. Condition of patient as to shock, hemorrhage; no apparent shock, no hemorrhage. Post-operative diagnosis same. Operation by name: Appendectomy, diverticulectomy.

Pathological report, December 29, 1920: Diverticulum of intestine, which on section shows a very thin muscularis with a thickened mucosa. The appendix shows moderate chronic fibrous changes.—Dr. F. H. Baker.

Progress: Convalescence was uneventful; patient discharged as "cured" January 17th, nineteenth day after operation.

Follow-up note: Returned to hospital April 1, 1921, having developed a ventral hernia in operation wound. Has gained twenty-two pounds in weight and had no recurrence of the symptoms which preceded the operation.

The outstanding features of the symptomatology in this case are: (1) Rather definite onset. (2) Rapid and considerable loss of weight. (3) Digestive symptoms consisting of pain and discomfort of rather uncertain character, but in general, corresponding to the period when the sac might be distended by partly digested food and radiating to the upper lumbar region. (4) Rather diffuse and inconstant tenderness in the neighborhood of the sac. The diagnosis depended upon the routine X-ray examination.

It seems remarkable that so well-formed a sac which would *a priori* seem to have existed much longer than symptoms attributable to it can be traced should suddenly become an active source of serious disturbance without having become subject to some superimposed condition such as ulcerative or in-

FIG. 1.— Röntgenogram of Case 1 showing diverticulum, with its relation to stomach and jejunum.

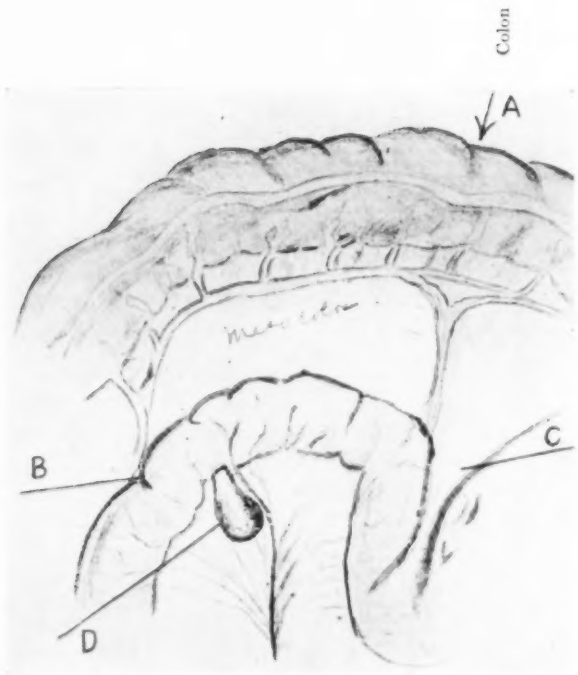

FIG. 2.—Sketch showing location of diverticulum and relations as found at operation in Case I.

FIG. 3.—Section of jejunum from Case II, removed at autopsy, showing diverticulum protruding between cut edges of mesentery.

flammatory changes. If we can assume a sudden development of such a lesion from mechanical strain, it becomes less puzzling. Doubtless herniation is a cause of many diverticula, as we not uncommonly find obvious herniation of mucosa in bowel distended from obstruction below and in such the muscularis is lacking in the sacculated portion. In this instance the muscularis mucosæ is present, but the muscularis itself is found only in segments at the point of section, which was at the side of the sac, hence it is possible that by slow pouching the mucosa was driven through a defect in the muscular layer near a point of penetration by the blood supply. The villi, glands of Lieberkühn, and solitary follicles are present as normally found in the jejunum, and there is no evidence of any inflammatory process. Symptoms must have been dependent upon distention when packed by intestinal contents and their development coincident with the attainment of a certain size in the pouching when immediate emptying was no longer possible.

Bearing these symptoms in mind and remembering the possibilities of ulcerative, suppurative and carcinomatous developments upon such a lesion, it seems probable that it will be more frequently considered in differential diagnoses and its true importance discovered.

The distinctive Röntgen findings in this case consisted of a well-defined shadow, of solid and constant density, uniform in its relation to the feathery coils of jejunum, yet movable independently of them. The "fluid level," mentioned by Roberts and Cole, was not observed.

Case II.—(By courtesy of a colleague.) No. a-19666. Male, aged forty-four years, divorced, laborer in street department. Entered April 3, 1921.

Past History: Negative, except for malaria as a young man. Constipation associated with vertigo and diplopia recently. Habits described as good and venereal not recorded. No loss of weight or swelling of feet.

Present Illness: About twelve hours prior to entrance began to have sharp pains and general discomfort in abdomen, accompanied by dizziness and nausea, vomiting everything ingested during day. Throat negative. Chest: lungs negative. Heart: slightly irregular with roughened aortic first. No murmurs. Blood-pressure, 134/88. Pulse, 80. Temperature, 99°. White count, 8400. Hæmoglobin, 90 per cent. Abdomen: generalized tenderness in lower right and left quadrants with point of maximum tenderness two inches below McBurney's point. This tenderness is very acute on deep palpation. Urine: specific gravity, 1002; no albumen; no sugar.

Preoperative Diagnosis: Appendicitis, acute.

Operation (ether, cone method): Found a retrocæcal adherent appendix five inches long which was removed with some difficulty and stump cauterized. Pulse did not exceed 96. Good ether recovery.

April 4, 1921: During forenoon had difficulty in speaking, followed in afternoon by inability to swallow. Examination showed pharynx dry and insensitive with apparent paralysis of muscles of diglutition. Pulse remained of good character, 76. Temperature, 98.6°.

April 5, 1921: Died suddenly at 3.50 A.M.

Cultures: Abdomen, no growth. Throat, no diphtheria. Pathological report: chronic appenditicis, no marked changes. Final diagnosis: (clinical) appendicitis, chronic. Acute bulbar paralysis.

Autopsy: Pia thickened and opaque over both hemispheres. Section of brain showed no gross lesion. Bronchi showed injection of mucosa with blood-tinged, frothy mucus. Lungs œdematous; moderate passive congestion of liver and spleen. Ecchymosis and a very little free blood about site of appendix; no peritonitis. Forty centimetres below upper end of jejunum, lying between folds of mesentery, is a diverticulum, size of an English walnut. Inflation of gut shows that its wall is much thinner than the intestinal wall. There is no surrounding inflammation. Kidneys enlarged, otherwise not grossly abnormal. Anatomical diagnosis: wound of recent appendix operation. Lepto-meningitis, chronic. Bronchitis, acute. Diverticulum of jejunum.

The cause of death in this case is obscure in spite of the autopsy. The low specific gravity of urine with œdema of lungs suggests a toxic condition, while lepto-meningitis is consistent with syphilis. A post-mortem Wassermann was negative.

Our reason for reporting it lies in the presence of the diverticulum. Could it not have been responsible for the symptoms attributed to the appendix? It will be noted that pulse, temperature and white count were but little disturbed, and while this is not extremely rare in very serious appendicitis, in this instance it may be interpreted as favoring the other hypothesis, moreover, the point of maximum tenderness was much below the actual level of the appendix.

We cannot go so far as to advise the administration of a barium meal in the face of an acute abdominal crisis with vomiting, nor do we consider the possibility of such a lesion as a contraindication for prompt operation in such an acute abdomen, but would suggest that in event of finding the suspected lesion absent or insufficient to account for the symptoms, diverticulum be kept in mind and the small bowel explored from end to end. In the less urgent cases and in obscure cases in general the possibility of these lesions should be carefully considered in the course of the routine Röntgen examinations of the gastro-intestinal tract.

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RADIUM TREATMENT OF CARCINOMA OF THE BLADDER

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of New York

Clinical report from the Memorial Hospital of New York

The treatment of carcinoma of the bladder at the Memorial Hospital has been divided into two periods, *viz.*, that prior to June, 1919, when we were testing what could be done with radium applied through the urethra and without opening up the bladder; and that period since June, 1919, when we have added to the intraurethral treatment the application of radium through the bladder opened suprapubically. The object of this latter phase was to destroy extensive bladder carcinomata which we had not been able to cope with through the urethra. The results of both these forms of treatment are herein reported and this paper is based upon all cases seen at the Memorial Hospital up to January, 1921, a period of nearly five and a half years. One hundred and forty-two cases of advanced carcinoma; four cases of small carcinoma; nine cases of extensive papilloma; two borderline cases.

Pathology—Classification.—In fifty-three cases of tumor of the bladder the pathological examination (Ewing) was as follows: Papilloma, seven cases; papillary carcinoma, eighteen cases; infiltrating carcinoma (variously called epidermoid carcinoma, malignant epitheliomata, papillary infiltrating carcinoma), twenty-two cases; adenocarcinoma of prostatic type (alveolar carcinoma), four cases; papillary adenocarcinoma, one case.

I can see no reason for making another class "malignant papilloma," which means that a tumor purely papillomatous in histological structure, either by its rapid growth or rapid recurrence after removal, shows more malignant tendencies than the usual papilloma. The term "malignant papilloma" refers to a clinical rather than a histological difference. In these fifty-two cases there was but one which could not be classified under the above heading, that of papillary adenocarcinoma. The four cases of alveolar carcinoma were probably secondary to a prostatic carcinoma.

Papillary Degeneration into Carcinoma.—There has been much written over the fact that papillomatas may remain such for a long period and then take on a carcinomatous degeneration (Mandlebaum, the Pathology of New Growths of the Bladder; *Surgery, Gynecology and Obstetrics*, September, 1907; Buerger, *Trans. of A. U. A.*, 1915). The basis for this rests upon two findings:

1. Clinical: A pure bladder papilloma may be observed at one time (cystoscopically and by pathological specimen), and a number of years later a well-developed carcinoma identified.

2. Pathological: The fact that a tumor shows in one part pure papilloma and in another part carcinoma may indicate that a benign papilloma has become carcinomatous.

We have seen patients with extensive papillomata of the bladder with histories dating back four, five, six years and more which showed at the time of examination no malignant changes (pathological examination, Ewing), and which had no induration at the base of any of the multiple tumors. We have also seen patients with carcinoma of the bladder (identified pathologically and cystoscopically) live for a number of years with their carcinomas. Our observations lead us to believe that many bladder tumors run true to their original histological structure. Many papillomata begin and end papillomata, and many carcinomas begin and end as such. We must, however, not forget that malignant degeneration may take place in a papilloma and therefore papillomata are potentially malignant.

History.—Age first seen—125 cases (121 extensive carcinoma, four small carcinoma). Twenty to thirty years, three cases; thirty to forty years, sixteen cases; forty to fifty years, twenty cases; fifty to sixty years, thirty-seven cases; sixty to seventy years, thirty-five cases; seventy to eighty years, fourteen cases.

The fifth and sixth decades showed the greatest incidence of carcinoma. Nine extensive papillomata of the bladder gave four cases between fifty and sixty; two cases between sixty and seventy; one case between seventy and eighty. So giving about the same age incidence as carcinoma.

Duration of Symptoms.—One hundred and twenty-one cases (116 advanced, five early carcinoma). One to three months, fifteen cases; three to six months, fourteen cases; six to twelve months, thirty-five cases; twelve to eighteen months, nine cases; eighteen to twenty-four months, sixteen cases; twenty-four months, 32 cases.

These tables emphasize that most patients with carcinoma of the bladder have symptoms for a year or more before their condition is seriously considered. If they could be seen earlier very many more could be cured.

Among the cases of extensive papilloma was one with symptoms dating back six years; he had extensive solid papillomata almost filling the bladder. There was no induration of the base of any of these; pathological examination (Ewing) showed papilloma. One extensive carcinoma of the bladder had bladder symptoms dating back fourteen years.

Sex.—On hundred and fifty-three cases—male, 119; female, thirty-four. This preponderance of males may signify that inflammation may be a causative factor in carcinoma of the bladder. Prostatitis and trigonitis (gonorrhœal) have no analogue in the female.

Loss of Weight and Strength.—Of 126 cases (124 advanced carcinoma), thirty-nine cases showed a decided loss of weight. Loss of both weight and strength is commonly supposed to be an accompaniment of malignant disease. These two as a symptom of bladder carcinoma generally appear late. In our records there are a good many cases of bladder carcinoma, too advanced for any therapy, which have kept both their weight and strength up to the time when seen. If the loss of weight be due directly to the carcinoma and not

secondary as *e.g.*, serious infection of the kidneys, then one may suspect that the carcinoma has grown beyond the bladder.

First and Second Symptoms.—One hundred and thirty-eight cases (135 advanced carcinoma, three small carcinoma).

Hæmaturia.—First symptom, seventy cases; second symptom, sixty cases; no hæmaturia, eight cases. This symptom of tumor of the bladder therefore appeared in 130 out of 138 cases. In recognizing this as a cardinal symptom in early cystoscopy and appropriate treatment thereafter lies the solving of the question of carcinoma of the bladder.

In eight extensive papillomas of the bladder, but one gave no history of hæmaturia.

Disturbance of Urination.—One hundred and eighteen cases (116 advanced carcinoma, two small carcinoma); first symptom, fifty-eight cases; second symptom, fifty-two cases.

The carcinoma in the majority of cases causes some urinary disturbance. Frequent urination, dysuria, polyuria, retention, incontinence.

Loss of Weight (116 cases).—First symptom, no cases; second symptom, five cases. Loss of weight comes on late in the disease.

Pain Down Leg (116 cases).—First symptom, no cases; second symptom, three cases.

This symptom so often seen in prostatic carcinoma is comparatively rare in bladder carcinoma and is almost always an index of nerve involvement by the carcinoma beyond the bladder.

EXAMINATION.—*Cystoscopy:* 1. Presence of Tumor. 2. Carcinoma or Papilloma. Usually the cystoscopic diagnosis is not difficult. If there is fresh bleeding, the best view of the bladder and tumor is made during irrigation. The red, fluffy papilloma may be confused with blood clots, and the gray, sloughy carcinoma with calcareous incrustation of the bladder. The examination of pieces of tumor obtained with the rongeur forceps (cystoscopic) or sticking to the cystoscope may confirm the diagnosis. Pieces of the white, sloughy portions of a tumor usually show nothing diagnostic microscopically.

Carcinoma or Papilloma.—It probably falls to our lot at the Memorial Hospital to see more carcinoma than papilloma. In five years we have seen very few, not more than five or six, papillomas which have been suitable for destruction by fulguration.* We have also seen many patients whose tumor has been fulgurated at length and often before they came to us with full-blown carcinoma. Extensive tumors of the red papillary type should be suspected of being carcinomatous, notwithstanding the oft-returning pathological report "papilloma." The more a tumor tends towards the flat type, the more malignant is it.

A raised thickened base means carcinoma. All sloughy tumors are carcinomatous.

* These are not included in this report.

Rectal Examination.—If there is extensive induration of the bladder base, that is an indication that the tumor has grown through the bladder. If the tumor or its base is felt, but, between the tumor and the examining finger, is interposed somewhat soft bladder wall the case is still suitable for exploration. In a number of such cases we have removed the tumor from the bladder for various periods of time. The examination should be made with a thin-gloved finger, the bladder must be empty of fluid.

Residual Urine.—This is rarely present if the prostate is not primarily involved and should always suggest the possibility of this.

Kidney Function.—In ten out of fifteen cases (operated upon) the kidney function was reduced. In a few instances this reduction was marked, the lowest phenosulphonephthalein output being 5 per cent. in the first hour and 7 per cent. in the second. This reduction in kidney function which occurs in perhaps two out of three cases of carcinoma of the bladder is of importance in determining the length of the operation, the kind of operation and the prognosis. We have had three interesting kidney conditions following the use of radium.

CASE I.—J. A. H., who had an infiltrative carcinoma of the right side of the bladder near the right ureter orifice. This was small and operable. It has been destroyed by radium now for four years. He also had retention of urine and a hypertrophied prostate. In the midst of his radium treatment he had a stormy time with retention of urine and pyuria. About a year ago it was determined that his kidney corresponding to the side occupied formerly by the carcinoma was a pyonephrotic sac. Either the carcinoma encroaching upon the ureter or cicatrization by the radium caused this kidney's destruction.

CASE II.—K. B. Had an extensive carcinoma of her bladder around the right ureter. Previous to radium treatment she had several very severe attacks of renal colic on the side corresponding to the tumor. For ten months subsequent to radium treatment she had no more attacks of renal colic. The tumor was by no means entirely gone, but apparently that portion around the ureter orifice was destroyed, so relieving her of the attacks of colic.

CASE III.—B., who had an extensive papilloma of the right side of his bladder. He had previous to operation a phenolsulphonephthalein output of 5 per cent. the first hour, and 7 per cent. the second hour. His bladder was opened suprapubically, the tumor snared off and radium imbedded in the base. For a number of weeks he ran a slight temperature, then considerable temperature and was found to have a large right kidney. His condition became progressively worse. I opened his kidney under novocain and found it to be hydronephrotic with the urine under tension and with pus in the kidney pelvis. This was drained, the patient became better for a number of weeks, then died septic.

Cystogram.—We have used the following technic at the Memorial Hospital to graphically show the tumor and the infiltration of the bladder wall.

The patient is placed flat on his back, a catheter is introduced into his bladder, and the contents emptied. With a large syringe the bladder is blown up with air until the patient feels discomfort. The radiograph is immediately taken without withdrawing the catheter from the bladder. We have in many cases compared the findings on opening the bladder with the results shown by cystogram, and find that in most cases they pretty accurately correspond. If a tumor is pedunculated its pedicle is not shown by cystogram.

Secondary Urethral Tumors.—We have seen a good many cases of urethral tumors either accompanying or following bladder tumors. I think we often overlook these small urethral tumors having our eye on the major condition. Whether these are real implantations from the bladder or a retrograde lymphatic invasion I hesitate to say. Most of these urethral implants are of the same structure as the bladder tumor, although I have lately seen a small soft urethral tumor in a patient in whom I had removed an indurated carcinoma from his bladder. I think it safe to consider them as malignant as the bladder tumor.

INDICATIONS FOR RADIUM.—1. *Local Removal from Bladder:* If the tumor is confined to the bladder it may be suitable for removal by radium. We have removed from the bladder (for various periods of time) all kinds of carcinomata, *viz.*, infiltrating, indurated, extensive, highly malignant.† This naturally does not mean that we have been uniformly successful; far from it. Different tumors react differently to radium.

2. *Hæmaturia.*—Radium fairly consistently controls hemorrhage, and may be used for this even if the tumor has gone beyond the bladder.

3. *Retarding the Growth of Tumor.*—The question is often asked, "Even if there is no hope of cure, will not radium retard the tumor growth so a patient may live longer and more comfortably?" Undoubtedly this is true now and again. The cases in which radium does this are so few, however, the failures so many, that I believe it unwise to give radium therapy in those cases in which there is no hope of removing the tumor from the bladder.

Reaction of Different Tumors to Radium.—Different papillomata showing precisely the same structure microscopically react differently to radium—some are destroyed easily and some resist. The same is true of papillary carcinoma, although as a rule papillary carcinoma seems to be more sensitive to radium than papillomata. Papillary carcinoma can be destroyed by surface radiation (using large doses of screened radium). Indurated carcinomata are best destroyed by the implanting throughout the indurated area small bare tubes of radium into the base of a tumor and leaving them there. These bare tubes are very caustic, and very local in their action, extending over an area of about one cubic centimetre. In using them even with great accuracy it is possible to miss come carcinomatous area. Therefore we use a combination

† The largest infiltrating tumor removed was as large as a hen's egg; had grown through the bladder wall and was adherent to the symphysis. This case is described on p. 760.

of the bare tubes (in the depth) and the screened radium (in the surface) in every case of indurated carcinoma.

Determination of Method of Radium Treatment.—I. *Intravesical:* Growths confined to and around bladder neck. Papillomata. Pedunculated papillary carcinoma if pedicle can be reached. Infiltrating sessile growths of no more than 2 cm. in diameter.

II. *Suprapubic:* Growths other than the above and without metastasis. Extensive infiltration of the bladder wall, large and multiple tumors are the indication for section, to which all doubtful cases are submitted.

Intravesical Methods: By means of a flexible spring holder used through the sheath of the Brown Buerger operative cystoscope a hundred or more millicuries of unscreened radium may be held up against the tumor for the period of half an hour while the tumor is being observed through the cystoscope. This may be repeated every two weeks, or less often if the tumor is disappearing satisfactorily. If the tumor looks solid or hard, or has a base which looks indurated, then we may treat it by thrusting into its base or the indurated part, a radium needle screened simply by the steel of the needle. This needle is also on a flexible spring and is used through the operating cystoscope. Needles from fifty to 200 may be used for a period of time up to forty minutes. We must remember that in this method the action is local and caustic. We have in a similar way implanted small bare tubes of radium into the base of a tumor and left them there. For this, bare tubes of 0.5 mc. to a square centimetre of tumor are used, and left in place. The action here is still more local and more caustic. We have used all of these methods and combinations of them in various tumors and by all of them have destroyed small or recurrent carcinomata of the bladder. If a tumor is more extensive, if it is papillary in character, if the pathological examination shows pure papilloma, and especially if it be around the bladder neck we often start the treatment by placing into the bladder two tubes of screened radium (.6 mm. silver, 2 mm. rubber). These tubes are inserted through the sheath of a straight cystoscope and tied with a string and left in place for varying periods of hours and then pulled out of the urethra by the attached string. As a rule we use two tubes of 50 mc. for five or six hours. The value of such radiation is first, to see how the tumor reacts to radium; second, to temporarily stop the bleeding to make cystoscopy possible, and third to destroy that portion of the tumor around the internal urethral orifice. If the tumor is carcinomatous and large, and we believe from our examination it is confined to the bladder, then we do the open operation described below.

Suprapubic Application of Radium in Extensive Carcinoma.—Because we were unable to cope with extensive carcinomas of the bladder by the intraurethral method, in June, 1919, we began to open up the bladders in selected cases and implant radium directly into the carcinoma. The technic is as follows:

Gas and oxygen anæsthesia is used. The bladder is prepared previous to operation by washing it out with a 1 : 4000 acriflavine solution, then draining the fluid out of the bladder and blowing the bladder up with air. The patient is placed in Trendelenburg's position. The skin incision is a long one, extending from the symphysis to the umbilicus. The prevesical fascia is cut transversely at the symphysis and dissected back, the bladder being exposed well down its posterior wall. The urachus is cut, and the exposure extends beyond this. The sides of the wound are screened with gauze soaked in acriflavine (1 to 4000) solution. The bladder is gently palpated so the incision may not go

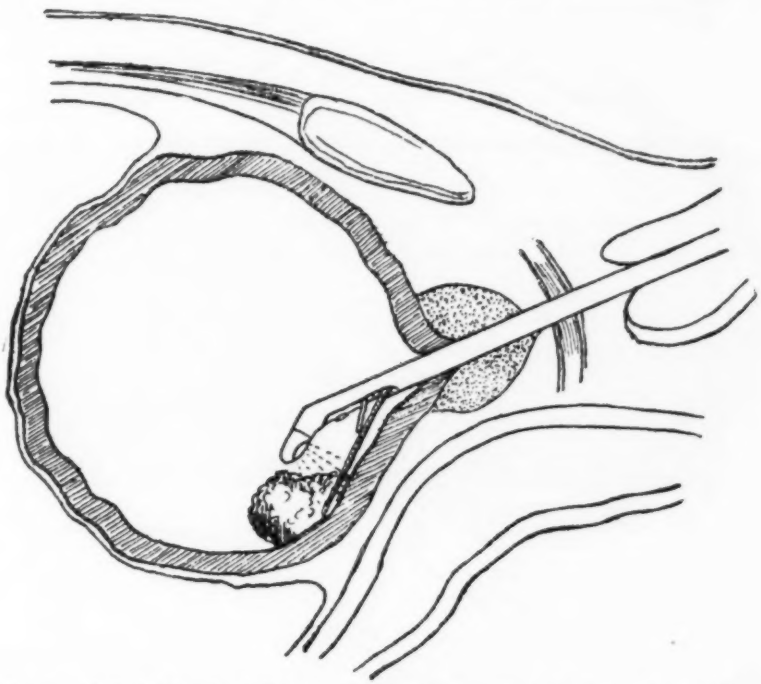

FIG. 2.—Method of burying radium emanation tubes in growth by means of special introducer and the cystoscope.

through tumor tissue. Between two clamps the bladder is opened and a three- or four-inch incision is made longitudinally. The cut surface of the bladder is grasped by clamps, the clamps being about one inch apart. The reason for this is that the bladder will otherwise collapse and fall down into the pelvis when retractors are put in it, so making operation impossible. A light is thrown into the bladder and bladder retractors three or four in number are gently placed in the bladder. The retractors which we have used most have been made for us at the Memorial Hospital. They are made of one-eighth-inch steel wire in the form of an open loop. The advantage of these is that the tumor may be seen through the open portion of the retractor, and treated. The tumor being exposed is sponged as little as possible to prevent bleeding and spreading of tumor cells. Alcohol sponges are used. Any pro-

truding portions of the tumor are snared off, using a simple wire snare. If the tumor is flat and not papillary in type, none of it is removed. The reason for snaring off the papillary part is to better expose and treat the base. Indurated parts of the tumor are implanted with radium bare tubes (0.5 mc.) by means of a needle, using two of these to the square centimetre. These bare tubes are not put in the normal mucous membrane, but within a quarter of a centimetre of the edge of the tumor.

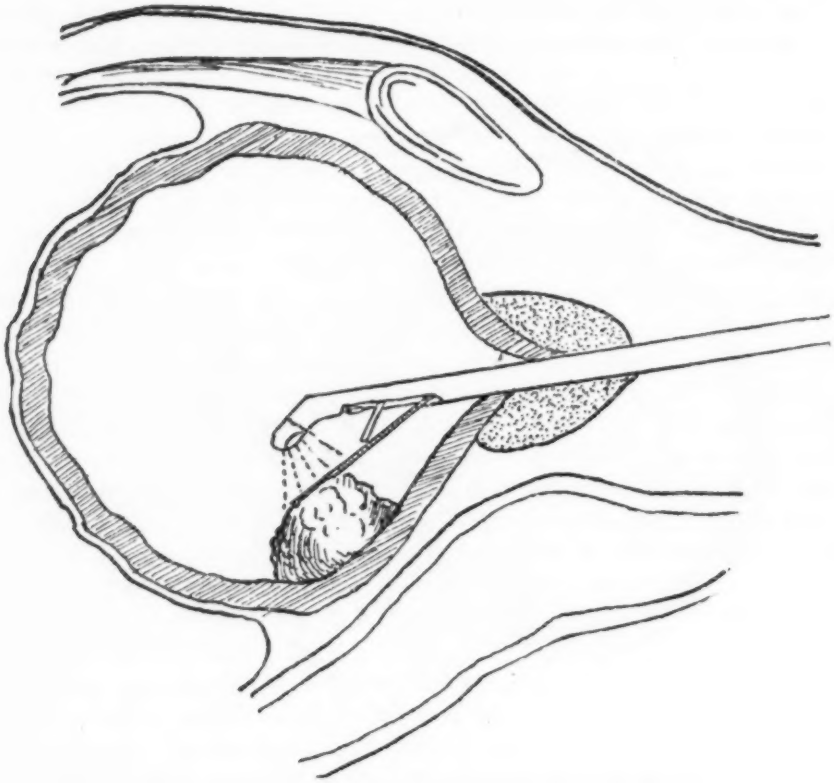

FIG. 3.—Surface application of radium emanations to growth under vision by means of special applicator in cystoscope.

Finally, surface radiation is accomplished by means of tubes of radium screened by 0.6 mm. of silver and two millimetres of rubber placed on the surface of the tumor and held in place either by gauze packing or little hooks on the silver tubes. A string is attached to these tubes, and they are pulled out after an appropriate time. A space 2½ c.c. in diameter is radiated by two of these tubes placed longitudinally side by side, 1 cm. apart. To such an area, 500 or 600 millicurie hours is given. Before placing these tubes in, a can of ether is emptied into the bladder to kill any stray tumor cells. The bladder is closed up with plain catgut, the strings of the radium tubes and the packing exiting through the small opening left in the bladder. The gauze screening in the wound

FIG. 1.—Tubes of radium emanations. The small tubes to right are "bare tubes" used to implant directly into tumors.

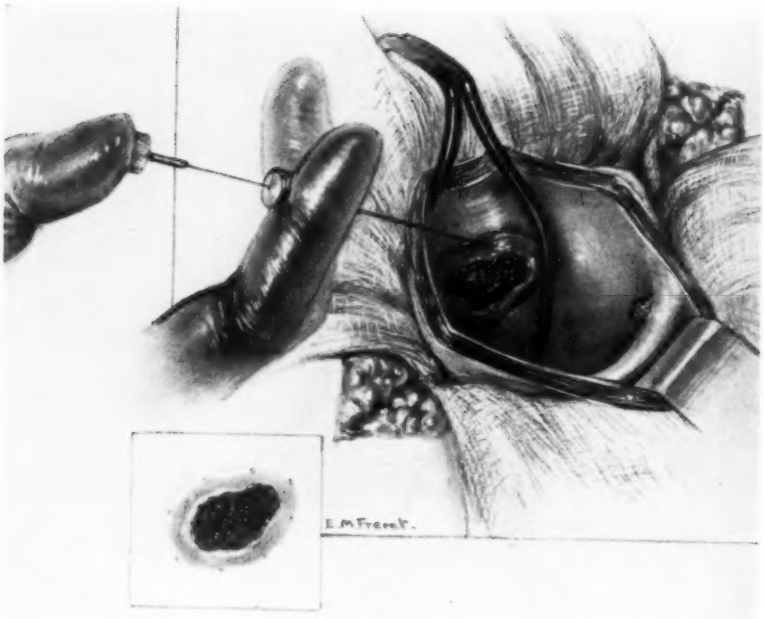

Fig. 4.—Burying radium emanation tubes under direct vision after exposure of carcinoma by suprapubic cystotomy.

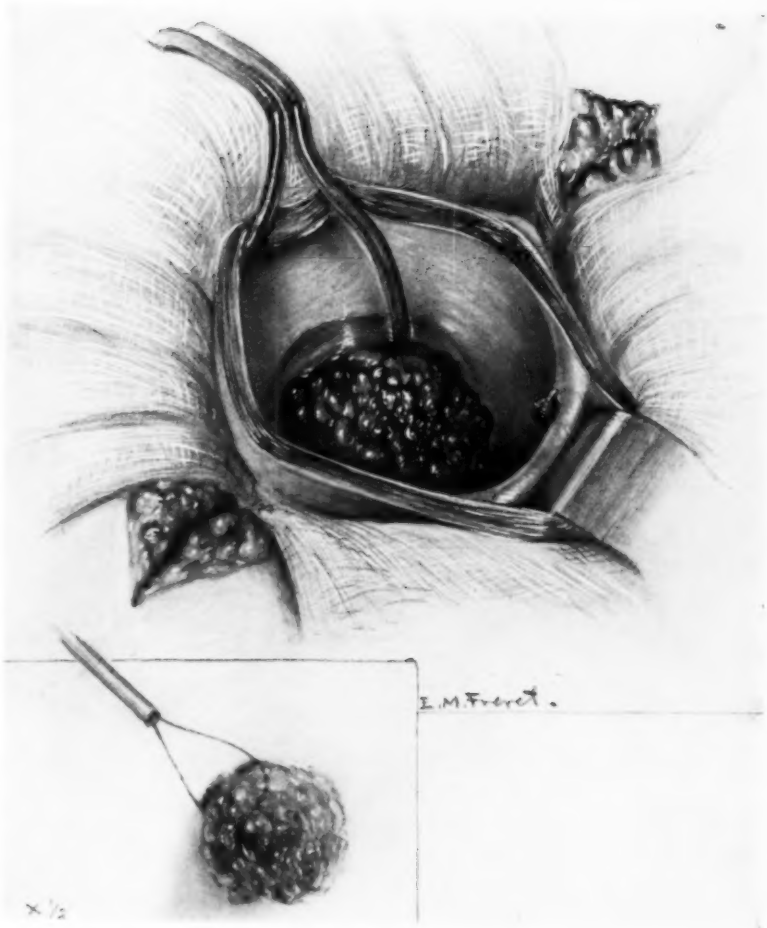

FIG. 6.—Use of special retractor in exposing clearly the carcinoma, especially its base. Snaring off pedunculated growth preparatory to burying radium emanation tubes in its bore.

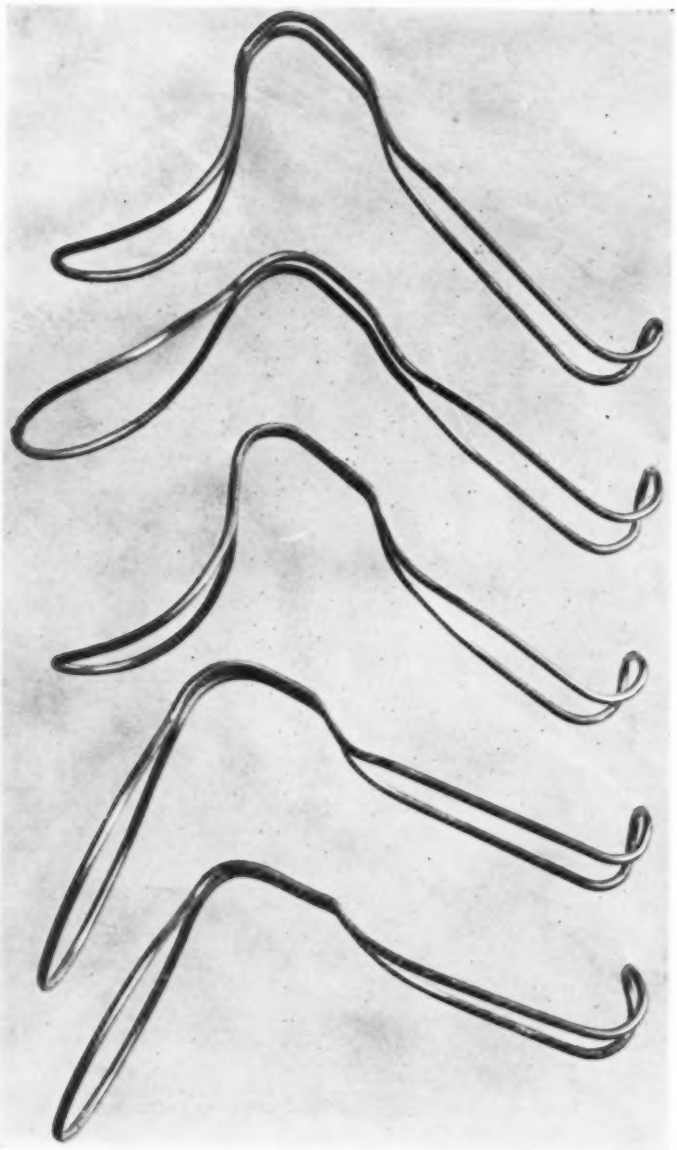

FIG. 7.—Bladder retractors used in the operative method of burying radium emanation tubes.

is now removed, and ether poured all over the wound. The wound is closed as usual. Two cases operated upon in this manner are here reported to show what can be done in inoperable (aside from total cystectomy) cases.

S. D., male, age thirty-seven. In 1917, nocturnal frequency of urination progressively increasing until he urinated every fifteen minutes. Never hæmaturia.

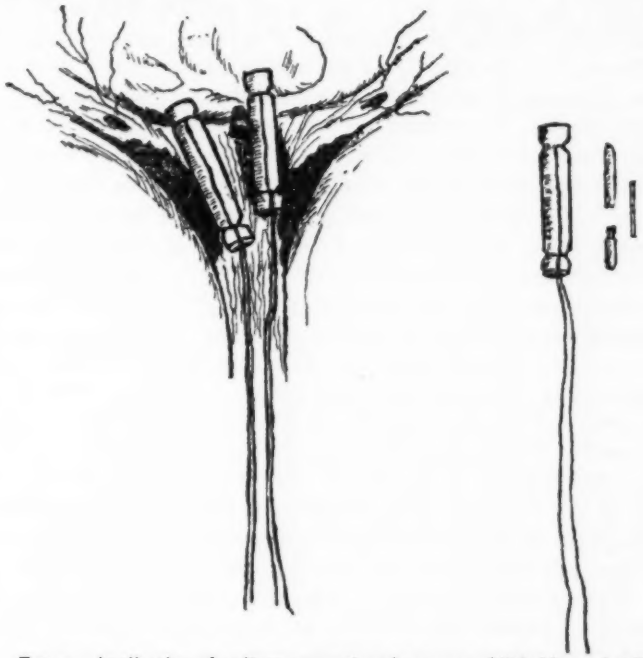

FIG. 5.—Application of radium emanations by means of "bladder tubes." (Radium emanations screened by small silver tubes which are inserted into short pieces of rubber tubing).

November, 1917, a small carcinoma of the bladder was excised. It recurred very rapidly. Shortly after leaving the hospital his frequency was as great as before.

In June, 1919, he came to the Memorial Hospital with complete retention of urine and had to be catheterized. I opened his bladder and found his bladder full of clots and red papillary carcinoma the size of a small orange attached to the left bladder base and lateral wall. The papillary portion of this was cut off with a cautery, and fifteen bare tubes of radium (3 mc. each) were planted in the base of the tumor which was of the size of a silver dollar and which included the opening of the left ureter. A suprapubic tube was left in for a number of days, then removed, the wound healing without trouble. He had burning and frequency for a number of months after operation caused by the radium. Cystoscopy, February 25, 1920, showed a bladder clean of tumor. There was no induration of its bladder base by rectal examination. He had gained thirty-nine pounds in weight and working all the time.

In January, 1921, cystoscopy showed a clean bladder with one or two very small papilloma of his posturethra. These were treated by radium.

H. W., male, age sixty-two. A single hæmaturia in January, 1920, then clear urine and again, February, hæmaturia. At this time he was cystoscoped and the diagnosis of "tumor of the bladder" made.

I first saw him in March, 1920. Then he was a well nourished man, had lost no weight, had a nocturnal urinary frequency of two. He passed urine colored with blood. The rectal examination showed slight induration of the middle of the bladder base with a normal prostate. The cystoscopic examination showed a tumor on the right side of his bladder, sloughy on the surface. It was impossible to tell its extent because of the hæmaturia. He gave a history of having had sugar in his urine but his blood sugar was not increased. He was but a fair operative risk. I opened his bladder and found a tumor on the right anterior wall, solid, of the size of a hen's egg. It had grown through the bladder wall and was adherent to the symphysis. We did not cut into the tumor for a specimen, but scraped off a slight portion of the surface which showed on examination mucus and pus. There was no doubt, however, of the clinical diagnosis of "carcinoma." This was the largest carcinoma that we had attempted to remove. We filled the tumor as accurately as was possible with radium tubes of 0.2 cm., two to a cubic centimetre, leaving these in place. The bladder was drained for a long time because I feared the sloughy results from the radium absorption of the tumor. The patient's recovery was uneventful, barring the fact that he had a persistent suprapubic sinus. Three months after my first operation I cut out the bladder sinus and sewed up the bladder. During this operation I searched with my finger the site of the old tumor, and could find nothing abnormal, barring a slight irregularity about 1 cm. square in the surface of the mucous membrane of the bladder. He was last cystoscoped in February, 1921, and his bladder, while slightly hyperæmic over the site of the tumor from the effects of the radium, showed no tumor. He is in the best of health, and has no symptoms except that he gets up once or twice at night to urinate.
to urinate.

Tables showing the results in both intravesical and suprapubic methods are appended to this article.

Intravesical.—We have removed the carcinoma from the bladder in eleven cases by the intravesical application of radium. The longest case has gone four years and four months with the bladder clean of tumor and proved by cystoscopy.

Suprapubic.—To January, 1921, we have operated upon twenty-nine cases of carcinoma of the bladder. There were no deaths directly after operation, although one died seven weeks post-operation, and one two months post-operation. Some of these patients showed carcinoma so extensive that no radium treatment was attempted. In ten of the twenty-nine cases the carcinoma was removed from the bladder, the longest case having gone twenty months post-operation with a bladder clean of tumor. Five of the

cases have not been cystoscoped post-operation. The remaining fourteen are dead or doing badly and one has not been traced since he left the hospital. There has been but one implantation of tumor in the operative wound in a case which was operated upon before he came to us—so we can divide the responsibility for this.

Examination of the chart will show how very extensive and inoperable all of the tumors were if we exclude cystectomy. I have never seen any operative statistics that at all compares with those of the above table.

EXTENSIVE CARCINOMA OF BLADDER—RADIUM IMPLANTED THROUGH BLADDER OPENED SUPRAPUBICALLY.

	No.	Name.	Age.	Date oper.	Description of tumor.	Pathology.	Previous oper.	Result.
	1	V.	36	June 1919	Papillary tumor, large as orange, base 5x5 cm., of left bladder base	Papillary infiltrating carcinoma (Ewing)	One	Bladder clean (cystoscopy) 20 months post-op. (Sl. papilloma of urethra)
	2	K.	54	Jan. 1920	Papillary tumors, indurated base (largest 3x3 cm.) all around bladder neck	0	0	Bladder clean (cystoscopy) 9 months post-op.
	3	W.	61	Mar. 1920	Solid tumor, ulcerated surface (6x6x6 cm.) on anterior wall of bladder, growing through bladder and adherent to pelvis	0	0	Bladder clean (cystoscopy) 12 months post-op.
Carcinoma of bladder....	4	W.	60	Apr. 1920	Pedunculated tumor (small tangerine) covered with incrustations, left bladder wall, indurated base	Papillary carcinoma (Ewing)	0	Bladder clean (cystoscopy) 9 months post-op.
Operated cases.....	5	G.	50	Apr. 1920	Solid, flat tumor 3x4 cm., within 1 cm. of left ureter	Infiltrating carcinoma (Ewing)	0	Recurrence after operation treated intravesically. Bladder clean (cystoscopy) February, 1921
Bladder clean on one or more cystoscopies post-operation.....	6	D.	33	May 1920	Solid tumor, left wall, 2x4 cm. Papillary tumors around bladder neck	Infiltrating carcinoma (Ewing)	0	Recurrence after operation. Treated intravesically (3 times). Mar., 1920 no tumor. Radium slough
	7	T.	59	June 1920	Flat, irregular tumor around urethra (treated by radium before oper.). Small tumor seen at oper.	Infiltrating carcinoma	0	No tumor 6 months post-op. Radium slough (cystoscopy)
	8	S.	55	July 1920	Papillary tumor, 4x5 cm., of left bladder base. Base indurated	Papillary carcinoma (Ewing)	0	Bladder clean (cystoscopy) 9 months post-op.
	9	W.	50	Aug. 1920	Indurated, ulcerated tumor, 3x3 cm., around sphincter of bladder	Epidermoid carcinoma (Ewing)	0	Bladder clean (cystoscopy) 6 months post-op.

	10	R.	70	Dec. 1920	Indurated, flat, irregular tumor, 3x3 cm., centering in 1. trigone & touching bladder neck	Papilloma (Ewing)	0	Bladder clean (suprapubic observation) 2 months post-op.
	1	H.	48	Sept. 1919	Number of hard nodules around bladder base. (Scar of radium in bladder neck from pre-op. treatment)	Papillary carcinoma (Brooklyn Hospital)	One	Eighteen months post-op. has sl. urinary frequency (once at night). No pain. Looks and feels entirely well. Refuses cystoscopy.
Carcinoma of bladder....	2	H.	56	Sept. 1920	Papillary tumor 6x4 cm. posterior to 1. ureter. Pedicle infiltrated. Base 3x3 cm.	Papilloma (Ewing)	0	Recurrence post-op. Still treated (March, 1920)
Not cystoscoped since operation.....	3	B.	49	Oct. 1920	Multiple hard tumors, bladder base & anterior wall; one 2x3x2½ cm; one 3x1 x1 cm.	Carcinoma (Brooklyn Hospital)	One	Not cystoscoped post-op.
	4	M.	50	Dec. 1920	Indurated ulcerating tumor touching internal urethra 4x3 cm.	Squamous infiltrating carcinoma (Ewing)	0	Not cystoscoped post-op.
	5	R.			Solid, rounded, nonpedunculated tumor, indurated base, touching left side trigone, 7x10 cm.	Papillary carcinoma (Ewing)	0	Not cystoscoped post-op.
	1	R.	59	July 1919	Whole bladder wall carcinomatous, not treated	0	0	Died 5 months later
	2	H.	42	July 1919	Extensive indurated carcinoma 10x5x2 cm., probably originating in prostate	Epidermoid carcinoma (Ewing)	0	Died 6 months later
	3	R.	47	July 1919	Indurated carcinoma around bladder neck, probably primary in prostate	Papilloma (Ewing)	0	Died 14 months later of anuria after pyelotomy to relieve obstruction of lower ureter caused by carcinoma
	4	W.	41	Aug. 1919	Extensive growth of bladder wall, coming from outside bladder (?)	0	0	Died 1 year later
	5	C.	60	Dec. 1919	Entire vault and sides of bladder infiltrated. Trigone clear	Infiltrating epidermoid carcinoma (Ewing)	0	Died 3 months later

EXTENSIVE CARCINOMA OF BLADDER—RADIUM IMPLANTED THROUGH BLADDER OPENED SUPRAPUBICALLY.—(*Continued*)

	No.	Name.	Age.	Date oper.	Description of tumor.	Pathology.	Previous oper.	Result.
	6	L.	38	Dec. 1919	Extensive, diffuse papillary tumor of anterior wall	Papillary carcinoma (Ewing)	0	Died at another hospital (3 months post-op.) from infarction of prevesical space due to sloughing of bladder wall by radium
Carcinoma of bladder								
Operated cases.....	7	S.	52	Feb. 1920	Indurated carcinoma (3x3 cm.) around internal urethra	0	0	Died 7 months later
Patients dead or doing badly or not followed...	8	L.	60	Apr. 1920	Mass size of golf ball, touching internal urethra base, 2x10 cm.	Carcinoma (Ewing)	0	Died 2 months later
	9	D.	69	Apr. 1920	Pedunculated tumor 8x4 cm. (base 3x3 cm.) attached to trigone	Papillary carcinoma (Ewing)	0	Died of uremia 7 weeks post-op. Bilateral pyonephrosis
	10	B.	43	Apr. 1920	Papillary carcinoma with indurated base (7½x4 cm.) touching right ureter	Papillary carcinoma (Ewing)	0	Operated upon twice. Now 6 months after 2" Operation has urinary frequency, but is in fair general condition
	11	R.	49	Apr. 1920	One carcinoma, lateral wall, 5x5 cm. x 1 cm. (thick); 1 carcinoma left trigone & urethra, 7x1 cm.	Infiltrating squamous carcinoma (Ewing)	0	Left hospital in good shape. Cannot be traced since.
	12	O.	50	Apr. 1920	Two sloughy tumors, 2½x1 cm. & ¾x½ cm.	Alveolar carcinoma (Ewing)	Once	Doing badly. Implantation in abdominal wound (Mar., 1921)
	13	B.	60	May 1920	Flat, indurated carcinoma, 10x7 cm.; implant 1x1 cm.	Solid carcinoma (Ewing)	0	Died 3 months post-op.
	14	E.	56	Aug. 1920	Sloughy, flat carcinoma, right bladder wall, 3x3 cm.	Carcinoma (Ewing)	0	Five per cent sugar in urine at time of operation. Died 3 months post-op. of perirectal abscess

EXTENSIVE PAPILLOMA OF BLADDER—RADIUM IMPLANTED THROUGH BLADDER OPENED SUPRAPUBICALLY.

	No.	Name.	Age.	Date oper.	Description of tumor.	Pathology.	Previous oper.	Result.
Papilloma bladder..... Operated cases.	1	W.	55	May 1920	Firm, red, papillary tumor, large as small orange, base 3x3 cm., external to left ureter. A second small tumor	Papilloma (Ewing)	0	Bladder clean (cystoscopy) 10 months post-op.
Bladder clean on Cystoscopy.....	2	Mc.	61	Oct. 1920	Tumor large as tangerine (calcareous incrustations), right lateral wall, base 2x2 cm. No induration base	Papilloma (Ewing)	0	Five months post-op. no tumor (cystoscopy). Radium slough
	1	W.	55	Apr. 1920	Bladder filled with papillomata; no induration of bases	Papilloma (Ewing)	One	Seven months after 1" operation was operated upon 2" time for suprapubic sinus & more papillomata. Still treated (March, 1921)
Papilloma bladder.....	2	C.	56	May 1920	Very large papillary tumor 7x7x7 cm., attached to bladder base, posterior to left ureter, base 4x4 cm.	Papilloma (Ewing)	0	Reports well 9 months post-op. Not cystoscoped post-op.
Operated cases not cystoscoped since operation or still treated.....	3	P.	63	June 1920	Entire bladder base & lateral walls covered with papillomata; no induration	Papilloma (Ewing)	0	Six months post-op. still papillomata. Being treated
	4	K.	56	Oct. 1920	Pedunculated tumor, 5x4x3 cm. anterior to r. ureter; no induration	Papilloma (Ewing)		Not cystoscoped post-op.
	5	S.	48	Dec. 1920	Entire lower half bladder filled with papillomata; no induration	Papilloma (Ewing)	0	Not cystoscoped post-op.
	1	B.	56	Sept. 1920	Three papillomata, bladder base, largest 4x4 cm.; no induration	Papilloma (Ewing)	0	Died 3 months post-op. Pyemia (after pyelotomy for pyonephrosis)

CARCINOMA OF BLADDER TREATED INTRAVESICALLY BY RADIUM. CASES IN WHICH TUMOR HAS BEEN REMOVED FROM BLADDER 1916 TO 1920, INCLUSIVE.

Case.	Age.	Sex.	Evidence of Carcinoma.		Extent.	Induration.	Urinary frequency D. N.	Wgt. loss.	Previous treatment.	Radium—Dose—Method.	Result.
			Cytoscopy.	Pathology.							
I. C. A. G.	69	F.	Cauliflower, non-pedunculated, sloughy	Carcinoma (Ewing)	Base 3 cm. in diameter over 1. ureter	?	3-4 3-4	0	Fulguration twice	100 mc. 8 hrs. Bladder tube	Bladder clean 4 yrs. 4 mos. Cystoscopy
E. J. S.	54	F.	Papillary, sloughy in part	Papilloma (Ewing)	All around bladder neck and trigone	Vaginal, 5 cm. in diameter	q. hr. 5-20	?	0	100 mc. 8 hrs. 2 bladder tubes. Repeated twice at 3 mos. interval	Bladder clean 1 yr. Cystoscopy. Well (letter) 4 yrs.
L. M.	70	F.	Papillary red tumor of bladder base	Carcinoma (Ewing)	Multiple large one on trigone	Vaginal, small area	Frequent & pain	0	Fulgurated 2 years	200 mc. 7 hrs. 2 bladder tubes	Bladder clean 2 yrs. then recurrence (rapid growth). Removed by radium 1 yr. Radium burn.
J. A. H.	62	M.	Rapidly growing, flat, ulcerated	Carcinoma (Ewing)	Small, operable near ureter	0	2-3	0	Fulgurated once	180 mc. 6 hrs. 2 bladder tubes. Repeated in 4 mos.	Bladder clean 4 yrs. (cystoscopy). (Kidney no function on side corresponding to tumor).
H. F. R.	68	M.	Sloughy papillary tumor	Papillary carcinoma (Ewing)	Extensive, bladder neck	?	q. hr. q. hr.	17 lb.	0	100 mc. 8 hrs. 2 bladder tubes. Repeated 6 mos. later for recurrence	1st, bladder clean 3 mos.; 2nd, bladder clean 1 ½ yrs. Well 2 ½ yrs. (letter)
A. T. V. W.	59	F.	Papillary tumor some slough, left trigone	Papillary carcinoma (Ewing)	2x2 cm.	?	2-3 2-3	0	0	100 mc. 6½ hrs. 2 bladder tubes. Repeated 6 mos. later	Bladder clean once (cystoscopy)
F. H. P.	63	M.	2 tumors, 1 necrotic, 1 red	0	Around bladder neck	0	q. 3. hr. 2	0	0	70 mc. 4 hrs. 2 bladder tubes	Bladder clean 4 mos. (Cystoscopy). Well 2 yrs. (letter).

G.	64	F.	Tumor, flat, ulcerating, r. lateral wall	Epidermoid carcinoma (Ewing)	2x3 cm.	0	q. 2 hr. q. 2 hr.	0	0	100 mc. 5 hrs. 2 bladder tubes. Base tubes (2 of 0.5)	No tumor 8 mos. later (cystoscopy). Radium burn.
W.	50	F.	Small, ulcerating, flat, back of l. ureter	Epidermoid carcinoma (Ewing)	3x3 cm.	0	0	0	0	100 mc. 6 hrs. 2 bladder tubes	No tumor 8 mos. later (cystoscopy)
H.	50	M.	Red, smooth, rounded tumor near r. sphincter	Questionable if Carcinoma	3x3x2 cm.	0	0	0	0	Base tubes (0.5) through cystoscope	No tumor 1 yr. later (cystoscopy)
S.	53	M.	Multiple, sloughy, around bladder neck	Carcinoma (?) (Ewing)	Multiple, largest 1x1 ½x3 cm.	0	?	0	0	100 mc. 5 hrs. 2 bladder tubes.	No tumor 2 mos. later (cystoscopy).

PAPILLOMA OF BLADDER

C.	60	M.	Bladder filled with grape-like masses, recurring post-op.	Papillary (Mandlebaum)	Bladder vauet (?) full	0	?	0	Operation	2 tubes 50, 8 hrs.	Sl. tumor 3 yrs. 8 mos. later. Treated. No tumor 3 mos. later.
Z.	42	F.	Multiple, red tumors around sphincter	Papillary (Ewing)	Multiple one 3x3 cm.	0	0	0	Fulguration	100 mc. 8 hrs. 1 bladder tube	Recurrence 3 yrs. later. Treated. No tumor 3 mos. later. Died hemorrhage.
R.	63	F.	Multiple, red papilloma trigone	Papillary Ewing)	5x5x4 cm.	0	0	0	0	90 mc. 7 hrs. 2 bladder tubes	Reported no papilloma 1 yr. later (cystoscopy)
O. D.	74	F.	Red, papillary growth behind l. ureter	0	5x5x5 cm.	0	0	0	0	100 mc. 8 hrs. 2 bladder tubes. Subsequent fulguration.	No tumor 9 mos. later (cystoscopy).

HÆMOSTASIS IN SUPRAPUBIC PROSTATECTOMY BY THE METHOD OF THE "LOST TAMPON"

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At the present time it is generally agreed among the majority of surgeons that suprapubic prostatectomy is the operation of choice in prostatic hypertrophy. The argument of a smaller group of surgeons for the perineal operation is based on its smaller mortality other things being equal. I shall not go into details as to the comparative merit of the two methods, but shall confine my remarks to the operative procedures which are necessary to make the suprapubic operation as safe against possible complications as an operation of this magnitude can be made. Cabot [1] says: "The high operation is, I believe, far more efficient and for this reason we might be willing to accept a higher risk, but not until it appears that we have reduced the mortality to the lowest possible figure compatible with efficient work. There are three factors which contribute most importantly to the mortality of the operation and to those I would direct your attention. These are the anæsthetics, the shock, entirely apart from bleeding, and the bleeding itself. It has, of course, been generally recognized that the control of bleeding was an important factor in the success of operation and yet I do not think that recognition has been as complete as the situation requires."

The complications which are apt to mar the results of suprapubic prostatectomy are, in order of their frequency, hemorrhage, shock, uræmia, sepsis. Shock, uræmia and sepsis we have learned to avoid, in the majority of cases which are at all considered operable, by the two-stage operation and local anæsthesia. It is the question of hæmostasis which is still a source of anxiety to the surgeon; and the many different methods advocated to deal with postoperative hemorrhage show, that up to the present this great danger is not adequately met.

The difficulty of reliable hæmostasis in prostatic hypertrophy lies in the peculiar anatomical conditions. After enucleation of the gland a large bleeding cavity is left which freely communicates with the bladder, more or less filled with urine. It is the inability of the surgeon to keep the bed of the prostate dry which is responsible for the severe postoperative hemorrhages, adding a certain avoidable percentage to the mortality.

The source of the bleeding can be the arteries and veins in the torn mucous membrane of the urethra and bladder. These vessels, however, are rarely large and of no great importance and can easily be dealt with by suture or the application of clamps. The dangerous hemorrhages arise from the bed of the prostate itself.

Let us consider for a moment what happens when we enucleate the prostatic gland. In order to understand this properly we have to take into consideration a few anatomical points. The prostatic tissue is surrounded by a thin but fairly resistant tunica propria consisting of connective tissue and smooth muscle fibres. This tunica is the only structure which deserves the name "prostatic capsule." External to this thin capsule lies the pelvic connective tissue which in front and on both sides of the gland make up the superior pelvic fascia. Posteriorly the pelvic fascia forms what is known as

FIG. 1.—Tampon inserted into bed of prostate.

Denonvillier's fascia. Between Denonvillier's fascia and the capsula propria of the prostate there are situated only very small veins which empty into the hemorrhoidal venous plexus. In front, however, and on the lateral aspects of the prostate there are placed between the capsula propria and the superior pelvic fascia the very large and important venous plexus of Santorini (in front of the gland) and vesical venous plexus (laterally to the gland). The wall of the wound cavity consists mainly of the original glan-

dular masses of the prostate proper which has been compressed by the hypertrophy of accessory prostatic glandular tissue which lies scattered in the neighborhood of the internal orifice of the bladder and throughout the whole part of the prostatic urethra. Thus it is seen that what we call prostatic capsule in the surgical sense is in reality compressed lateral lobe of the prostate gland. In performing suprapubic prostatectomy, therefore, we remove these accessory hypertrophied masses, whereas the true prostatic tissue is left in the wall of the wound cavity. These findings of Lehndorf [2] have been confirmed by Freudenberg,[3] who made his interesting anatomical studies on patients who had died from the operation. The hypertrophy of the prostate was confined exclusively to that part of the gland which lies between the internal orifice of the urethra and the mouth of the ductus deferentes.

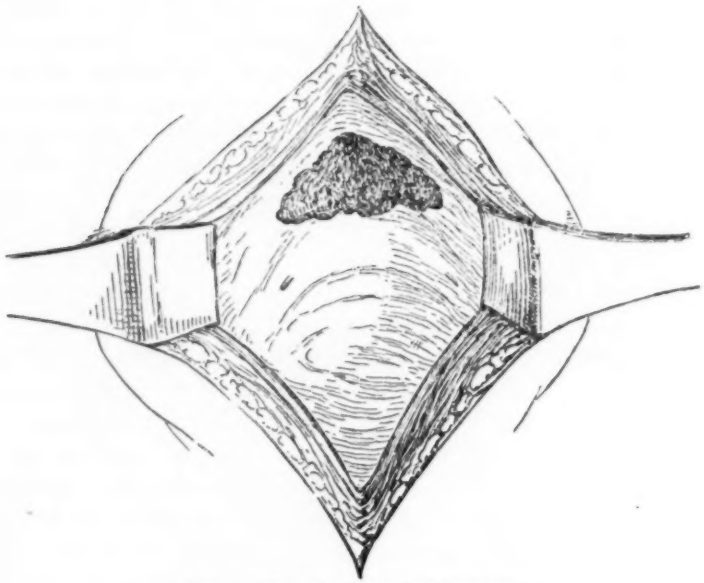

FIG. 2.—View of prostatic bed from above.

Ordinarily, therefore, the bleeding comes mostly from the mucous membrane of the urethra and the bladder and the compressed prostate tissue in the wall of the cavity. The hemorrhage from these tissues is usually not excessive. The dangerous hemorrhages must originate from injuries of the plexus Santorini and vesical plexus which are only protected by the thin, although fairly resistant capsula propria; it can easily be understood that injuries of the venous plexus are possible, especially in difficult enucleations. This would also explain our experience that severe hemorrhages occur not in all cases of suprapubic prostatectomy, but only in a certain percentage of cases in which these venous structures have been inadvertently injured.

Methods of Control of Hemorrhage.—Three different procedures have been recommended:

1. Packing of the prostatic bed by gauze tampon.
2. Continuous irrigation with hot saline or mildly antiseptic fluids.
3. Mechanical contrivances as the Hagner and Soresi bag.

The method which suggests itself naturally is the gauze tampon on account of its simplicity and ever-readiness. However, it was found that in spite of careful packing hemorrhage could not be controlled and surgeons therefore looked around for other reliable means.

FIG. 3.—Bladder closed over tampon.

Suter,[4] in speaking of hemorrhage, remarks that none of the various methods in use against it constitute a guarantee.

Squier [5] packs cavity with strip of gauze which is led out of the bladder through a large drainage tube.

Beer [6] also packs with a strip of gauze attached to a heavy silk thread which is passed through the bladder drainage tube. Thompson recommends against the danger of bleeding internal administrations of chloride of calcium two days before operation, a procedure which Augier criticizes on account of

the danger of thrombosis and embolism caused by the increased coagulability of the blood.

Freeman [7] employs a strip of iodoform gauze, or gauze soaked in some styptic material. The end of the gauze is retained in the grasp of a pair of blunt forceps. He leaves the clamp in the bladder, its ends projecting from the wound. He exerts pressure upon the clamp by passing an ordinary rubber bandage around the patient's body beneath the pelvis and over the notch between the locked handles.

Barringer [8] publishes practically the same method a few years later and cites as disadvantages of the method: (1) Patient keeps wet; frequent changes of dressings are necessary. (2) Packing in prostate cavity causes certain amount of pain. Continued irrigation of hot fluids either saline or some

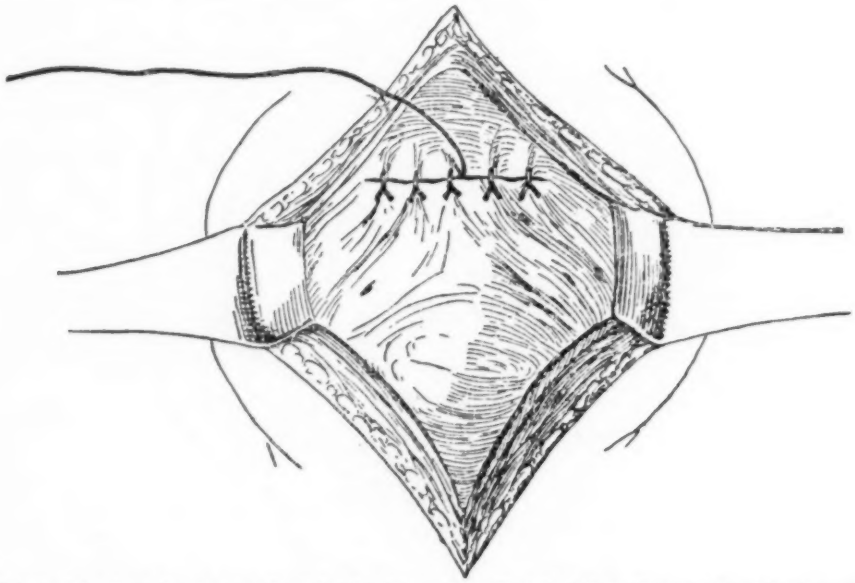

FIG. 4.—View from above, prostatic cavity closed by sutures silk string led out through epicystotomy wound.

mildly antiseptic lotion has been often tried. I myself have used it in a few cases, only to experience in one case a rather profuse bleeding one hour after operation, necessitating reopening of the bladder and packing.

Freyer [9] recommends bladder irrigation with hot boric lotion (temperature 110° F.) through the catheter still *in situ* for the purpose of removing clots and further to control bleeding. He advises, however, that this process should not be continued for more than two or three minutes, as he finds from experience that these irrigations not infrequently promote bleeding, instead of diminishing it, if the irrigations be continued too long. Hagner has recommended a rubber bag which is introduced into the cavity of the prostata and is kept distended by air. A similar contrivance has been used by Soresi [10] in which the bag is kept distended by mercury. The objection to these

mechanical contrivances is that they easily get out of order, are cumbersome and not always at hand.

The best means after all to control hemorrhage is the simplest and one which does not need special instruments, *i.e.*, packing with gauze. Why is it then that this means so universally successful in other regions of the body is so singularly unreliable in controlling hemorrhage in the prostatic cavity?

The principal reason for this in my opinion is the failure of the gauze tampon to stick to the tissues for any length of time on account of the continuous soaking of the same by urine flowing down into the bladder. This fact has been recognized by Freeman and Barringer (athough they do not specifically mention it), who try to overcome this soaking loose of the gauze by continuous pressure exerted upon the tampon by a clamp or a sponge-holder. Deaver [11] and Kammerer [12] were the first to employ sutures of the intravesical wound edges over the tampon.

Deaver says: "It is necessary * * * to so perform this operation that fatal hemorrhage and sepsis will be rare events, instead of the extraordinarily common ones which they are at the present time if the mortality of prostatectomy is to be reduced * * * and in the event of hemorrhage it is often difficult to apply gauze packing. This is then the one certain way to control hemorrhage after prostatectomy. Distensible bags and similar playthings are effective only in cases in which there is no bleeding." In another article he advises the following: Before introducing the gauze into the prostatic bed carry a continuous suture through the upper margin of the lateral walls of the cavity, the free ends of the sutures to be tied tightly after the gauze projects through the incision in the abdominal wall. Kammerer uses a similar procedure. After placing the tampon into the bed of the prostata, the opening of the prostatic cavity is partly closed by a transverse suture of strong plain catgut, passing through the entire thickness of the bladder wall and the capsule of the enucleated prostata. The upper end of the opening is not sutured. Through this opening the tampon is passed into the bladder and further through the suprapubic opening into the gauze dressing. The sutures were placed without tying them, the tampon was then introduced and was of such a size that when the sutures were tied a certain amount of compression of the tampon would take place. A Freyer tube was put into the bladder above the projecting end of the tampon and wound was closed. The tube and the tampon were removed on the third day.

Author's Method.—After the prostate has been removed, the edges of the wound are caught up with a few Allis' clamps and thereby kept apart. A strip of iodoform gauze is tightly packed into the cavity until all its recesses are well filled. The projecting part of the tampon is cut off. If the hemorrhage is controlled this tampon is removed and used as a pattern for the size of the final tampon. The final tampon is secured by a stout silk ligature fastened around its middle and its whole mass is introduced into the cavity. Before the tampon is definitely placed, the prostatic cavity is once more care-

fully cleaned of all blood coagula which may have accumulated. After introduction of the gauze pack the wound edges are tightly sutured with strong plain catgut over the tampon, the silk thread being let out between two sutures and through the suprapubic wound. The prostatic cavity is thus completely shut off from the interior of the bladder. A drainage tube is fastened in the bladder in such a way that it does not touch the bladder fundus, and the bladder and the abdominal wound tightly closed around it.

The prevesical space is also drained by a small cigarette drain. For placing the sutures I use the so-called "boomerang needle holder" constructed by Young, which is the best instrument I know for the application of deep-seated sutures. After three or four days the sutures have become loose and the tampon can be withdrawn by pulling on the silk string, the drainage tube being removed at the same time.

I have used this method of hæmostasis by "the lost tampon method" for all my prostatic work in the last six years and have had no postoperative hemorrhage, neither have I seen any untoward symptoms which could be attributed to the method.

The main advantage of my method I see in the ability to entirely close off the prostatic bed from the bladder, thereby preventing the tampon from being soaked loose by the accumulating urine. Another advantage is that the urine which is always more or less infected does not come in contact with the fresh wound cavity. The urine does not stagnate in the recesses and infection is less apt to occur.

In closing this article, I came across a short reference in the *Centralblatt f. Chirg. No. 40*, 1920, p. 234, in which Rubritius at a meeting of the freie *Vereinigung der Chirurgen Wiens*, March 11, 1920, states that for controlling hemorrhages he uses "a lost tampon" with string attached.

Whether he closes the cavity by suture is not mentioned.

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DEFECTS OF THE PATELLAR BORDER

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AND

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Many surgeons during the late war must have been greatly puzzled, as was the senior author of this paper, by not infrequent cases of obscure disability of the knee joint. The cases as I saw them gave no history of injury, or if they did it was of such an indefinite character as to produce the impression that it was the result of suggestion. The disability was nearly always unilateral. The knee was swollen but not particularly hot and not red. The swelling was not great but the resultant stiffness and pain were quite enough to render the patient unfit for military duties for a varying time. A curious feature of the cases was that the swelling appeared infrequently and almost always after a route march. No case presented itself as having occurred in consequence of games after retreat. It was this fact which made me suspicious until I became convinced by the number and by the actual physical appearance of the joint area that there was really some disability of obscure origin. None of the radiograms taken of those cases falling under my care showed clear signs of any anomalous or pathological condition, but at that time I was unaware of the condition which we are about to discuss in this paper so that I cannot say that a careful search with this special feature in mind would still have resulted in negative findings. It is certainly true that the disability is a real one and that patients with this disability are not class "A" men. On my return to civil life I determined to investigate anew the vast amount of material in the Hamann Museum with the especial purpose of discovering, if possible, some adequate cause of the disability. Since the history of the cases failed to give indubitable evidence of trauma and the condition did not as a rule result from ordinary activities in a young man's life, it seemed necessary to look for some slight lesion or some anomaly, as the result of the presence of which, repeated slight trauma regularly applied, such as that due to the continuous and somewhat monotonous action of the knee in a route march, might light up the condition. In the routine examination of skeletons accruing to the museum during my absence with the troops I noted the patellar anomaly herein described, and the suggestion formed itself in my mind that there was a possible cause of the condition observed in the army. The material was therefore turned over for investigation to the junior author (W. C. McC.) who has worked it up into suitable shape for publication. The senior author (T. W. T.) however is solely responsible for the form of presentation. While the work was already under way the important article by Salmond[2] appeared. This

confirmed the impression given by the purely anatomical study here that clinical condition and anatomical appearance should be correlated.

HISTORICAL REVIEW

Emargination of the patella was first described by Kempson in 1902[1] as a common variation in which there is a depression in the upper portion of the outer margin of the bone. The depression varies from a very small and insignificant one to a large area involving the patella quite deeply and extending from half an inch from the median vertical line of the bone to half way down the outer margin. Upper and lower extremities may be marked by spicules or sharp bony points. The condition is equally present in ancient and modern bones. The area of defect corresponds with the area of attachment of the vastus lateralis muscle.

In 1904 Wright reverted to the question of emargination in consequence of discovering a case of "accessory patella."[3] The anomalous patella which Wright describes consists of a larger medial part and two lateral portions, upper and lower. Together the two lateral "accessory patellæ" include the greater part of the lateral border of the bone. Two cases of emargination are also figured and it is suggested that both emargination and accessory patella are variants of one anomaly resulting from more than one center of ossification for the patellar area. Possibly the accessory centers are not in the quadriceps tendon but in the ilio-tibial tract of fascia lata.

Salmond in 1919 as the result of his observations in the service came to the conclusion that there is a fissured fracture of the patella of not infrequent occurrence, not conforming with the usual type, and with an indefinite history of injury.[2]

The fracture described by Salmond is a fissure situated at the outer border or at the external superior angle of the bone in the neighborhood of the vastus lateralis insertion. It is sometimes a slight crack with no displacement, but in extreme cases the whole border of the patella is detached with "callus thrown out to bridge the gap." The patient never came to the X-ray department with a diagnosis of possible patellar fracture but always for an inflammatory condition. Sometimes more than one fragment is found. History of trauma is vague and cannot be depended upon. Nevertheless Salmond considers the cases to be of traumatic origin. They may be unilateral or bilateral.

It will be necessary, as a result of the views expressed by the authors quoted above, to examine very carefully the patellæ under investigation so that a decision may be made as to how far the condition should be considered an anomaly and how far trauma may be responsible.

TYPES OF EMARGINATION

Very many patellæ show merely the slightest indication of a difference between the upper and outer part of the circumference and the remainder of the margin. A typical example of this condition is shown in Fig. 1, which is a photograph of the patellæ of No. 775, male, colored, age thirty-seven

years. As with all photographs illustrating this article the patellæ are shown from behind and at two-thirds natural size unless otherwise stated. This variation is so often met with that it would be impossible to give any idea of its frequency. In any case its frequency would not be important: the interesting fact is its occurrence at all. There is apparently no reason why the site of insertion of the vastus lateralis should differ from that of any other of the muscle quadriceps group. At the age of thirty-seven slight lipping occurs as a regular age change at the patellar margin. This lipping has no relation whatever to so-called rheumatism or arthritis. One can be quite dogmatic upon this point although the full evidence for the assertion has not yet been published. This subject forms the body of a future publication. Such lipping as occurs in this specimen does not involve the emarginate area, a circumstance which must give the observer food for thought.

The condition found in Fig. 2 is still more striking. This illustrates the appearance of patellæ from Cadaver 831, male, white, age forty-seven years. The lipping in this specimen is much more pronounced than that of ten years earlier, but though it forms an outstanding rim to the remainder of the margin there is little or no encroachment upon the area of emargination. It is extremely doubtful if there existed any emargination previous to the occurrence of lipping. Indeed we are inclined to believe that this is a case of spurious emargination due entirely to the presence of lipping. If this be the case it does not detract from the interest of the specimen but rather enhances it for it indicates that there is some reason why lipping does not take place at all readily at this site.

Fig. 3, showing the patellæ from No. 795, male, colored, age fifty-four years, at first seems plainly pathological. The lipping so pronounced elsewhere however does not involve the outer margin of the bones, and adjacent to the area of typical emargination is a pathological exuberant bone growth. The facts that this is bilateral and almost symmetrical, and that it involves just this particular portion of the patellar surface, suggest that there is some cause for the picking out of the area, although actually it may be nothing more than a remarkable coincidence. We have observed in other parts of the skeleton that areas which for some special reason are particularly vulnerable are picked out by a pathological lesion with remarkable accuracy and we are strongly of the opinion that this case should be so interpreted.

Whatever difference of opinion there may be about the last specimen the pair now to be presented permits of no uncertainty. This is No. 494, male, white, age forty-two years. It is represented in dorsal view (Fig. 4) ventral view (Fig. 5), and by transillumination (Fig. 6). Figs. 4 and 5 are two-thirds natural size, Fig. 6 is of actual size. This is a very important case and illustrates beautifully one type of the condition which specially interested Salmond. There is a fissure almost but not entirely separating the upper and lateral portion of the patella from the remainder of the bone. The condition is bilateral and almost symmetrical. On the left side the area might be considered to have been separated by violence and reunited. On the

right side the fissure is not complete. The central view (Fig. 5) would bear the same interpretation. There are however certain facts which reduce the possibility of violence as causative to vanishing point. The condition is bilateral. There is little likelihood that both patellæ would be so symmetrically damaged by a single act of violence. It is equally unlikely that two similar accidents at different times would happen to one individual. The left patella which shows the greater separation has a relatively great breadth, which is characteristic of bones exhibiting this anomaly and could not be accounted the union of a fracture. Both bones are very thin in the area of the "fissure," as shown by the manner in which the light has penetrated in Fig. 6. This method of photographing bones by transillumination was first suggested to us by Dr. W. W. Graves of Saint Louis. In this case it picks out beautifully the slight amount of lipping which has taken place at forty-two years. Neither Fig. 4 nor Fig. 5 shows the lipping with anything like the clearness exhibited in Fig. 6. It is rather unlikely that such a fracture, did it occur, would heal by bony union, in view of the tendency for the ventral periosteum and tendinous fibers to slip in between the separated fragments. The intrinsic evidence is therefore quite against fracture and in favor of anomaly.

Occasionally in place of or in addition to emargination there is found either on one side only or symmetrically a "punched" out depression in the dorsal (articular) patellar surface. A bilateral instance of this condition is shown in Fig. 7, which represents the patellæ of No. 425, male, white, age about thirty-six years. These holes extend well into the body of the bone. Their margins are rounded and not elevated. The walls are smooth and sloping and the base is coarsely cancellous. There is no evidence about them of tuberculosis or of inflammatory reaction. Otherwise the knee-joint surfaces are normal and there is nothing in our record of the case to point to a possible pathological origin. The holes are undoubtedly anomalies of patellar development.

As if to insure our acceptance of the statement made in the preceding paragraph, namely that patellar depressions are a form of anomaly closely linked with patellar subdivision, we are able to present Fig. 8. This shows the patellæ of No. 309, male, white, age sixty-six. Lipping occurs on both bones but is minimal in the area of emargination. Patellar subdivision is present only upon the right. In it typical broadening of the bone takes place and the upper and outer part of the patella is missing. That there was a completely separated piece of the bone now missing is clearly indicated by the specimen itself. The surface which lay in contact with the accessory portion shows a smoothed cancellous appearance which we have come to associate only with a bony surface resulting from fracture with non-union or congenital separation. There is considerable lipping on the ventral margin and this again indicates that there has been in fact a separate ossification. Now on the dorsal margin, in a position corresponding with the location of the pits in No. 425, and visible in Fig. 8, is a conical pit burrowing into the substance of the bone and similar in every way except in size with the pits of

PLATE I—Defects of the Patellar Border.

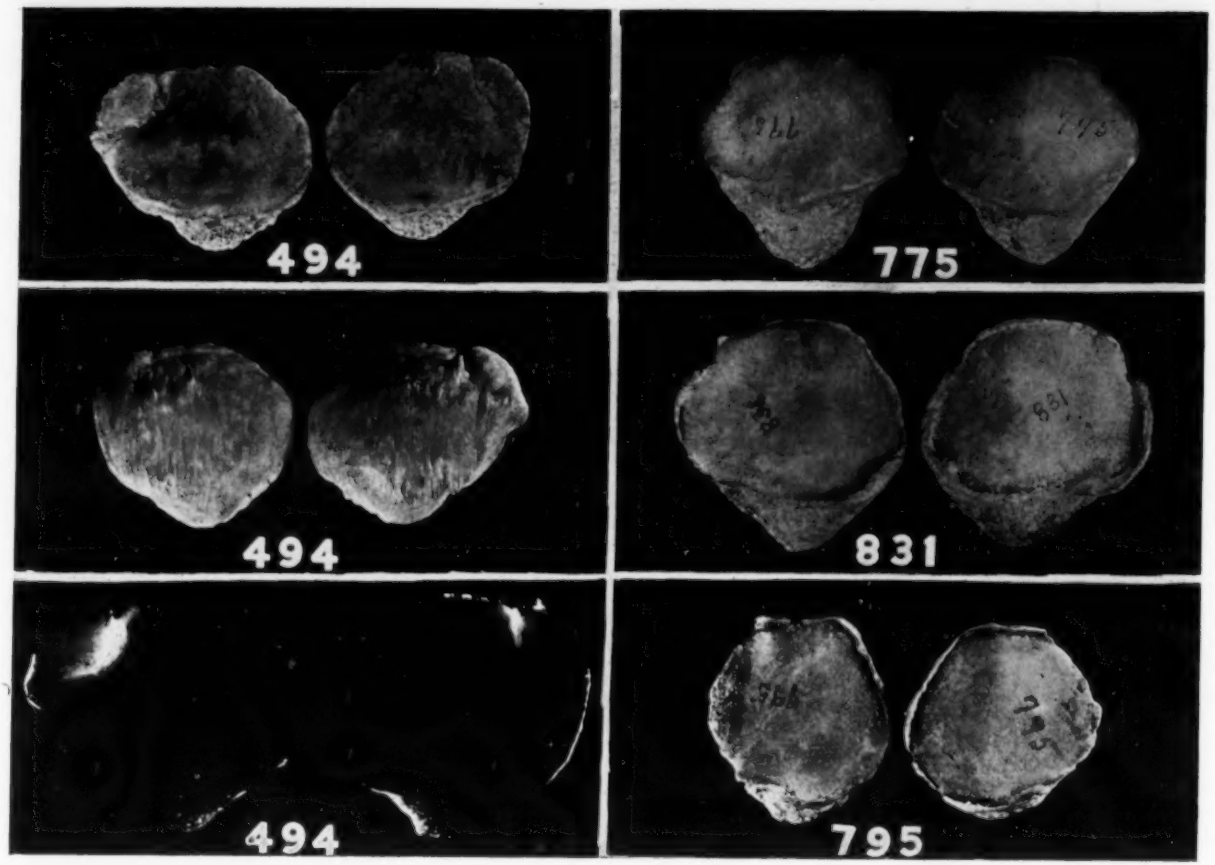

FIG. 4, 5, 6.

FIG. 1, 2, 3.

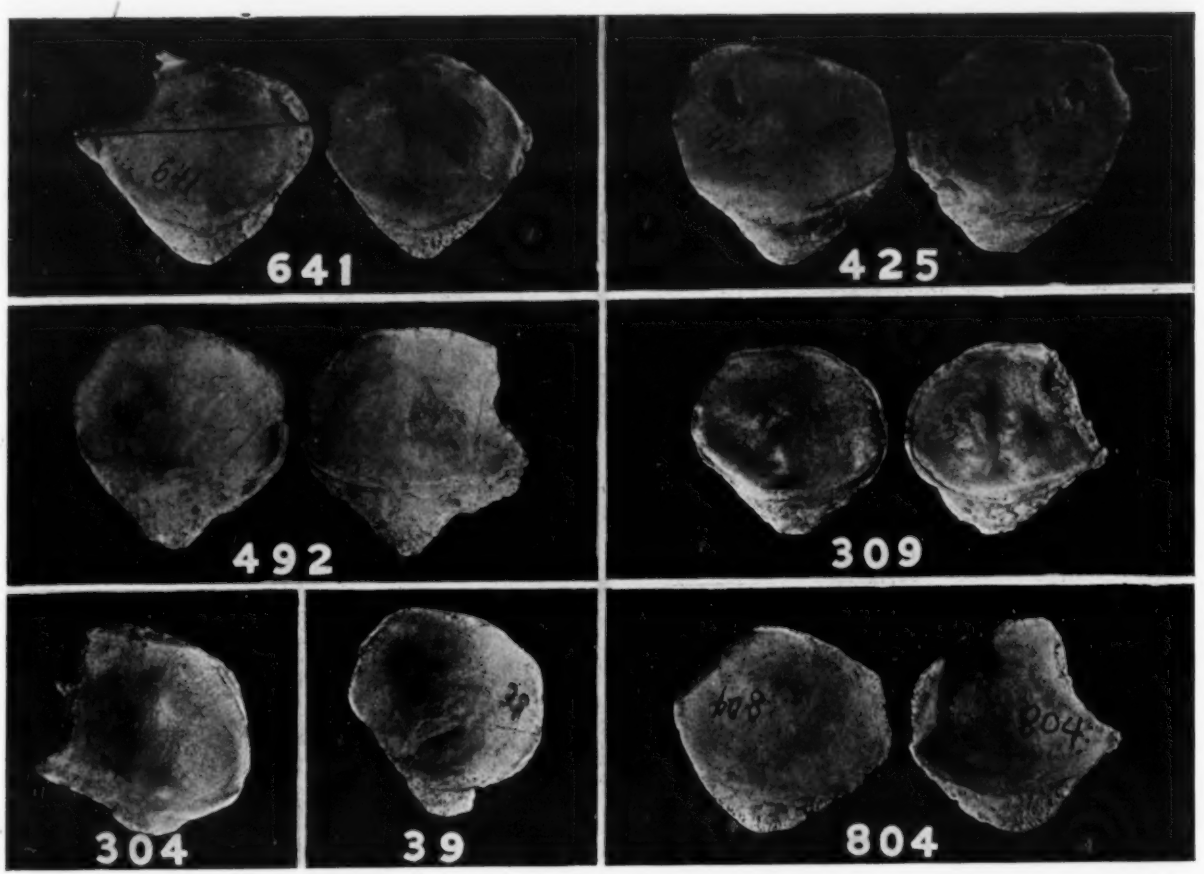

FIG. 10, 11, 13. FIG. 12. FIG. 7, 8, 9.

PLATE II—Defects of the Patellar Border.

PLATE III—Defects of the Patella Border.

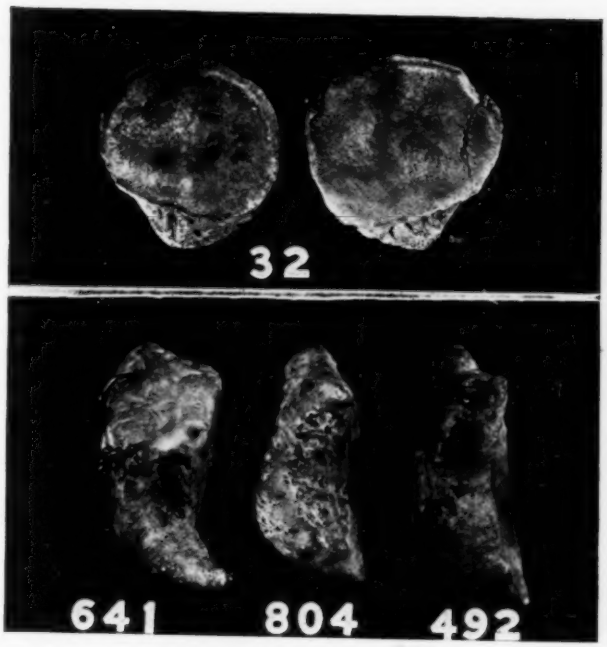

FIG. 15. FIG. 14.

No. 425. From these and other similar examples we are convinced that patellar pits and patellar subdivisions are phases of one anomaly.

A very similar case but without the patellar pit is No. 804, male, white, age forty-three years, shown in Fig. 9. Because of its age there is scarcely any lipping of these bones and in this respect the specimen differs markedly from No. 309. There is in addition no lipping of the emarginate area. This again is probably an age characteristic. The emarginate surface shows that the accessory ossicle has been entirely separate. The left bone shows slight emargination.

Fig. 10 illustrates another very marked example of emargination. It is a photograph of No. 641, male, white, age fifty-three years. There is the usual transverse broadening of the bone. The spicules at the extremities of the area are exceedingly well marked in this specimen. The accessory ossicle is preserved in this case but unfortunately it was omitted from the photograph. The condition though marked is unilateral. The emarginate surface shows that there has been complete separation of the accessory bone but no pseudo-articular surface is developed. This specimen is practically a duplicate of one described by Kempson.[1]

No. 492 (Fig. 11) is a particularly interesting specimen. It comes from a male white cadaver fifty years of age. There is a well marked emarginate area on the right bone, and partly encircling, but extending below it, there is a fine hair line on the print which is the mark of a second separation of original bony centers. Although it is faintly marked one has no doubt that this bone is one similar to that described by Wright as having two accessory ossifications. Turning to the left patella we note a similar hair line demarcating the lower and more medial part of the bone. From this occurrence we should infer that original ossification of the patella may be from several centers distributed somewhat irregularly in occasional individuals.

As illustrative of the various sites of separate centers of ossification we include Fig. 12, the left patella from No. 39, male, white, age forty-seven. Examination of this photograph will show that the lowest part, to which is attached the patellar ligament, has ossified separately here. The mark of the union of the two parts, slight as it is, shows on both dorsal and ventral aspects.

Fig. 13, the left patella from No. 304, male, white, age seventy years, shows a marked lipping of the emarginate area consequent upon age but equally indicative of complete separation of the accessory ossicle.

Fig. 14, the patellæ from Cadaver No. 32, male, colored, age about forty-two years, is quite important, for in it we note the ossification of a slighter grade of emargination which is bilateral with a typical "fissure" indicating a separate ossification center in a very usual position. It might be doubted why we have associated the slighter grade of emargination with extensive "fragmentation" of the patella. This specimen gives our reason. We believe that all these conditions which we have just described are simply phases

of one type of anomaly, namely that in which the patella is not ossified from a single center but from two or more.

The last illustration (Fig. 15) shows the emarginate areas on specimens Nos. 641, 804, 492, respectively, in order from left to right. In all it will be observed that the typical cancellous surface has been smoothed over by a more or less complete compact shell, as always occurs when two portions of bone, originally or normally one, are separate and sufficiently loosely attached to each other to permit of slight movement.

DISCUSSION OF FINDINGS

In the foregoing pages we have presented a consecutive and fairly complete series of patellæ showing what we believe to be various phases of an anomaly of patellar ossification. In the course of the description we have adduced evidence against the assumption of violence or indeed any degree of trauma as a causative agent. The conditions which we have featured have been noted by previous workers both anatomically and radiographically. We have not attempted to give a complete historical record, believing the multiplication of descriptions of single instances of one phase alone to be of little value. We have preferred to give a comprehensive survey of the phase first hand as the volume of material accessible to us in this laboratory permits us to do.

If however our contention as to origin be correct there should be found in children from three to five years of age some definite evidence in favor of our position. We have examined the patellæ of the six skeletons of approximately the proper age in this museum but have not had the good fortune to find any which show more than one center of ossification in the patella. Nevertheless there must be such cases and undoubtedly they will be found in time.

The patellæ of twenty-three full-term fœtuses were dissected out in order to examine the cartilaginous predecessor of the bone for evidence regarding a future subdivision of the patella. The most striking result of this investigation was the discovery that in forty of the forty-six specimens a portion of the cartilage was found to differ from the remainder in that its color was lighter and upon the surface, though not throughout the thickness of the patella, it was definitely demarcated from the rest of the cartilage. This special area lies in the typical site of emargination, namely at the upper and outer portion of the patellar margin. Under the microscope this seemingly separate portion was found to be entirely superficial. Hence although its presence is suggestive one can draw no definite conclusions regarding patella ossification from it.

Admittedly the part of our investigation which relates to the child and the fœtus is devoid of the result for which we had been led to hope by the variations in adult condition. Nevertheless we are convinced that we are dealing with an anomaly rather than with a fracture. For this view we have given our reasons on previous pages relating to specific cases.

Apart from the intrinsic evidence of each specimen against trauma as

the provoking cause there is the fact that emargination occurs twice as frequently on both sides as it occurs on one side only, judging from our material. As to the age incidence we do not obtain among the 682 skeletons which have been examined for this condition any convincing evidence that it occurs more frequently as age increases. It is not a very frequent anomaly, but occurs on one or both sides in three per cent of our cadavers. That all the pronounced cases are found in males is no indication of a sex distinction for our male skeletons are about seven times as numerous as our female skeletons. It is quite possible to examine 100 female skeletons and not find one instance of an anomaly which has a frequency of only three per cent.

ASSEMBLED RESULTS

We may now briefly summarize our observations in the following manner:

There is a condition of the patella occurring in about three per cent. of human beings characterized by more or less marked defect of the upper and outer part of the bone.

Certain minor defects which are ill marked and show up best when lipping of the patella becomes a prominent feature are not included in the estimate of three per cent. These occur much more frequently.

The area in which patellar defect occurs presents certain differences from the remainder of the bone even in the cartilaginous condition. In the adult lipping is exceedingly slow to make its appearance in this area. Pathological conditions of the articular surface are prone to present themselves in this area.

The area to which reference has just been made is known as the area of emargination. It is associated with the attachment of the vastus lateralis tendon.

Patellar emargination may occur as a very slight defect. There may be a much larger defect in the bone which may or may not be occupied by a separate ossification. Again, there may be incomplete separation of the patellar portions.

Associating with or occurring in place of patellar defect there may be a condition of deep pitting of the articular surface.

No indication of recent or old callus formation is present on any of our specimens, whether of complete or incomplete separation of the patellar portions.

No indications of inflammatory processes cocur in relation to either patellar defect or excavation.

Lipping of the margins of the emarginate area occurs with age; this must not be mistaken for callus formation.

A history of trauma is not given by the cases in which patellar defect is found.

The condition occurs on both sides twice as frequently as upon one side.

There is no convincing evidence that the condition occurs more frequently with increasing age.

We have been able to present all phases of the development of the

condition, although the results of our investigations upon children are unsatisfactory.

There is no doubt that the patella sometimes ossifies from separate centers in the vertical axis. We have presented specimens showing the probability of other centers of ossification in individual instances.

As the result of the findings just summarized we believe that the condition is an anomaly and not a fracture.

RELATION TO TRAUMA

In the previous section we have reiterated our conviction that the so-called fissured fractures of the upper and outer part of the patella are merely variants of the condition known as patellar defect or emargination, and are not due to trauma so slight that the patient is unable to give a clear account of its occurrence. We do not thereby mean to infer that trauma has no relation to the appearance of symptoms. Far from that we are in entire accord with Salmond in holding that symptoms occur after some slight and often unrecognized strain or injury. It is apparent that a knee joint, the patella of which is not a single bone, but consists of two or even more separate and possibly slightly mobile ossifications, cannot be considered a normal joint. It is conceivable that such a joint will be susceptible to insults which would produce no appreciable effect upon a normal joint, and it is evident that these insults will be more likely to occur in repeated movements of the limb more or less unaccustomed, such as military drill or route marches. Further, the effect of strains upon a composite patella of the type herein considered will be much more pronounced than upon a normal bone. Their effects will persist longer and be more liable to recur. Although we insist that the condition is a true anomaly we admit the condition is a disability the gravity of which will depend upon the precise phase of the anomaly exhibited. Symptoms of disorder may never appear until some slight and possibly unrecognized trauma evokes them.

SUMMARY

For a summary of the results of this investigation the reader is referred to the two last sections of the paper.

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ON THE TRAUMATOLOGY OF THE SESAMOID STRUCTURES

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This article has been preceded by an anatomical study of the sesamoid structures published in the *Journal of Anatomy,* London, July, 1921. As there are several debated points about the traumatic pathology of the sesamoids, mainly due to the reading and interpretation of skiagrams, it was advantageous that any clinical data should be given after a preparatory anatomical research based on radiologic findings. The results of these anatomical, morphologic and radiologic investigations may be summarized, as follows: The metacarpo-phalangeal sesamoids of the pollex were seen in 98.2 per cent., those of the index and auricular in 64.2 per cent. and 44.6 per cent., and those of the middle and ring fingers in 5.3 per cent. and 7.1 per cent. of cases. The interphalangeal sesamoids of the pollex were seen in 22.3 per cent. No other interphalangeal sesamoids were seen radiographically.

An (?) "epilunatum," a "pretrapezium," and the "os triquetrum secundarium" or the "ulnare antebrachii," and a possible "naviculare bipartitum" were seen in 1 per cent. of the carpal cases. One hundred and twelve skiagrams of hands and wrists were examined.

The metatarso-phalangeal sesamoids of the hallux are a constant feature of the foot. The metatarso-phalangeal sesamoids of the fifth toe appeared in 10 per cent. of cases, and those of the fourth and second toes in 2 per cent. and 1 per cent. The interphalangeal sesamoids of the hallux were present in 5 per cent. and those of the second and third toe in 1 per cent. of cases. The inner or tibial metatarso-phalangeal sesamoid of the hallux was congenitally divided in a transverse direction in 4 per cent. of cases. In one case (1 per cent.) there was an extra intersesamoid of the hallux (Fig. 1). The outer or peroneal metatarsal phalangeal sesamoid of the hallux was not seen congenitally divided.

Among the tarsal formations the "os trigonum" was seen in 7 per cent., the "os peroneale" in 5 per cent., the trochlear process of the talus in 5 per cent., the "os tibiale" in 2 per cent., the secondary "os calcis" and an intertalo-scaphoid in 1 per cent. (Fig. 2). The secondary cuboid, intermetatarseum, intercuneiform, division of the first cuneiform and the problematic "os vesalii" were not seen in any of the 100 skiagrams of feet examined.

All these bones have an evolution identical with that of any other cartilaginous bone. The reason why the "os peroneale," for instance, appears in some skiagrams too far behind the calcaneo-cuboid line depends on the degree and starting point of its ossification at the postero-inferior part of the cartilaginous nucleus (Fig. 3). The great development of the hallux sesamoids is an anatomical feature of the biped deambulation of men.

Irregularities of ossification of the tarsal navicular bone, which is morphologically a very complex structure of the human tarsus, might assist in explaining the pathology of the so-called Köhler's syndrome. The "os tib-

iale externum " appears constantly in the tarsus of the sea-lion, for instance.

I have examined 100 skiagrams of the foot, dissected several feet, and studied histologically the " os peroneale."

The outer gastrocnemius sesamoid was found in ten out of fifty skiagrams of the knee. In 100 X-ray plates of the patella I could find no evidence of " patella bipartita."

The so-called bicipital, tricipital, and supinator brevis sesamoids of the upper limb were not seen in any case, and the same can be said of the lower limb, so-called psoas, gluteus, and gracilis sesamoids. Any sesamoid may have one, two or more centres of ossification. A congenital division of these structures is shown by a regular line and no marked diastasis of the fragments, or by a concavo-convex line of separation. The bilaterality of the condition is confirmatory, but not essential for the diagnosis of congenital division. The peroneal metatarso-phalangeal sesamoid of the hallux very rarely appears normally divided, and the facility with which it normally assumes a position in the digital cleft on following abduction of the hallux, explains the rarity of its trauma. These points have a great bearing on the common diagnosis of the so-called fractures of the hallux tibial metatarso-phalangeal sesamoid and the rarity of cases reported of fracture of the hallux fibular sesamoid.

I have divided these structures into: *Supernumerary bones* and *sesamoids*. The first are formed by those bones that have a well-defined morphological ancestry, such as the gastrocnemii formation so common among dogs, foxes, otters, monkeys (" cynocephalus anubis "), etc. The latter are the fibrous, cartilaginous or osseous elements seen in the human limbs in the neighborhood of the joints, excluding pathological findings, such as the traumatic formations improperly called bicipital, tricipital, etc., sesamoids.

The kinetic theory alone does not suffice to explain the existence of the sesamoids. Pressure, traction and friction are not the essential causes in the formation of these structures. Any articulation of the types of enarthrosis or condylarthrosis requires the presence of intra- or periarticular elements of a sesamoid nature, which are perpetuated by phylogeny and enlarged in size by motion.

Fracture of the sesamoid bones was observed much earlier in animals than in man. Youatt, in 1866, quotes two interesting cases of fractures of the sesamoids in horses. He describes one case as follows: " Fuller was galloping steadily and not rapidly a horse of his own when the animal suddenly fell as if he had been shot. . . . He verified that both the perforans and perforatus tendons of the near foreleg were completely ruptured, just when they pass over the sesamoid bone, which was fractured in a transverse direction. The sesamoid of the off leg was fractured in the same direction, but the tendons were entire."

Schunke (1901) appears to have been the first author to describe a case of sesamoid fracture in man. Since Schunke's case was published, several others have been reported, and latterly with comparative frequency. A

FIG. 1.—Illustrates a third intersesamoid of the metatarso-phalangeal joint of the hallux. This is neither a case of longitudinal division nor a traumatic diastasis.

FIG. 2.—Shows a well formed os tibial, and the supra-trochlear process of the talus. Both were symptomless.

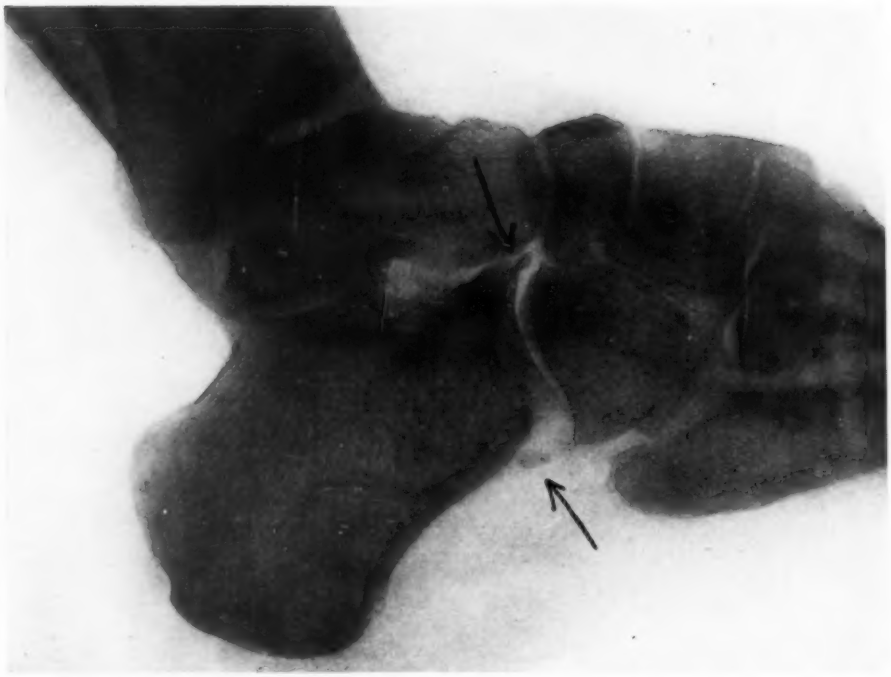

FIG. 3.—Shows the ossification of the "os peroneal" at the postero-inferior part of its cartilagenous nucleus and a rudimentary secondary os calcis.

FIG. 4.—Shows fracture of the neck of the 2nd, 3rd, 4th and 5th metatarsals, a dislocation of the metatarso phalangeal joint of the big toe and a T shaped fracture of the fibular sesamoid of the hallux. Note the wide gap between the three fragments of the broken sesamoid.

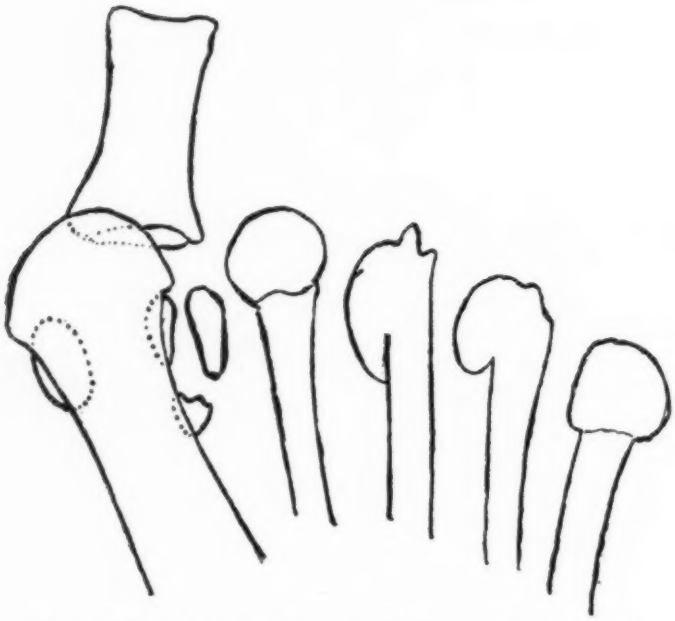

FIG. 5.—Diagram demonstrating the preceding Fig 4. Note wide gap between the fragments of the fibular sesamoid fracture, and a slight degree of luxation inwards of the tibial sesamoid.

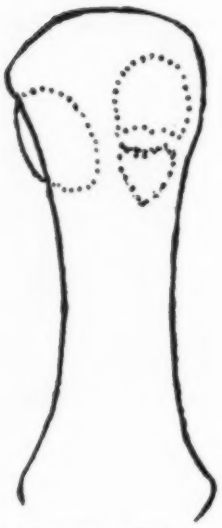

FIG. 6—Diagram showing a fracture of the tibial sesamoid of the hallux. Diagnosis based on the width of the gap of the fracture.

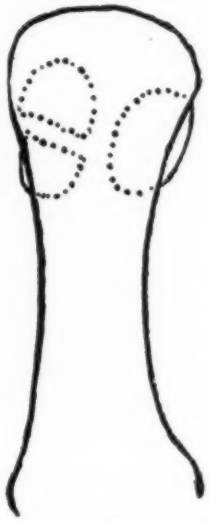

FIG. 7. — Fracture of the tibial sesamoid of the hallux. The direction of the fracture is slightly oblique. In this last case there is only very slight degree of luxation of the fibular sesamoid.

list of some cases of fracture of the hallux metatarso-phalangeal sesamoid is given herewith:

AUTHOR:	YEAR	CASES	BONE
Schunke	1901	1	Tibial sesamoid
Marx	1904	1	Tibial sesamoid
Polak	1906	1	Fibular
Muskat	1906	1	Tibial
Momburg	1907	2	Tibial
Stumme	1908	2	Tibial
Igelstein	1908	1	Fibular
Morian	1909	5	Tibial
Morian	1909	1	Fibular
Morton	1910	1	Tibial
Painter	1910	1	Both bones
Royer	1911	1	Tibial
Müller	1912	1	Tibial
Speed	1914	4	Tibial
Speed	1914	1	Fibular
Boardman	1915	1	Tibial
Eiken	1916	1	Tibial
Eiken (refers to)	1916	4	Tibial
Orr	1918	1	Tibial
Hall-Edwards	1918	1	Tibial
Scales	1918	1	Tibial
Bizarro	1918	2	Tibial
Carreras	1919	4	Tibial
Mayet	1920	1	Tibial
Serafini	1920	2	Tibial
Mouchet	1920	1	Tibial
Colleschi	1920	1	Tibial
Herman-Johnson	1920	1	Tibial
Freiberg	1920	12	Tibial
Freiberg	1920	2	Fibular
Bizarro	1920	1	Fibular

This table shows the rarity of the involvement of the fibular sesamoid of the hallux. A full analysis of all the above cases is unnecessary, as it has already been supplied, with reference to some, in the papers by Müller, Boardman, Orr and Serafini. Sir Robert Jones has had in his clinic several cases of fracture of the sesamoids of the hallux, and this fact "has often been associated with hallux valgus where symptoms had followed injuries."

Among my three cases the most recent is of particular interest:

CASE I.—Man, twenty-three years of age, engine driver. In August, 1920, while sitting on a motor-lorry his right foot got pushed in, as the result of a collision. The toes became suddenly hyperextended. The foot became swollen and tender, preventing him from walking, and he had ever since to go about on crutches.

I examined him on October 15, 1920, and found that the first phalanx of the hallux was dislocated upwards. The X-ray examination (Figs. 4 and 5) revealed fracture of the neck of the second, third, fourth and fifth metatarsals and a *T-shaped fracture of the fibular metatarso-phalangeal sesamoid of the hallux.* The fragments were widely separated and irregularly placed. The skiagram of the left foot revealed nothing abnormal.

On October 19, 1920, I performed the reduction of the dislocated phalanx

through a dorsal incision. It was difficult to maintain the phalanx in place. The extensor tendon was lengthened and the foot placed in plaster.

At the beginning of January the patient was walking comfortably and wearing an ordinary boot. Six months after the injury there was no radiologic evidence of bony union of the sesamoid fragments. The physiological recovery was complete and the movements of the metatarso-phalangeal joint of the hallux only slightly limited in the flexion.

CASE II.—Man, twenty-nine, laborer. Stepped left foot against a stone in June, 1918. I examined him in August, 1918, on account of pain and some local swelling confined to the inner side of the foot, at the level of the first metatarsal head. The X-ray examination revealed a *transverse division of the hallux tibial metatarso-phalangeal sesamoid of the left foot* (Fig. 6), with some separation between the two fragments. The anterior bit of bone is larger than the posterior. The skiagram of the right foot was normal.

After massage and wearing transverse metatarsal bar across the sole of the left boot, this patient was able to walk without difficulty within a month.

CASE III.—Woman, forty-nine years. She complained for some time of marked pain in right foot. There was no local swelling and no special location of the pain. The skiagram revealed a *transverse division of the hallux tibial metatarso-phalangeal sesamoid of the right foot* (Fig. 7) and some bony changes in both feet like rheumatoid arthritis. There was a small spur in the second metatarsal head. She remembered having knocked her right foot, sometime previously, against the curb of the footsteps. Massage and a transverse bar improved her condition.

The *mechanism of fracture* of the hallux sesamoids is not quite clear. Stumme and Morian have proved experimentally in the cadaver that forcible dorsiflexion and abduction of the toe may give rise to a fracture of the tibial sesamoid of the hallux. Marked comminution may be obtained by hammering the foot with or without boots on.

Case I seems to demonstrate conclusively that marked extension of the toes, which in this case went so far as to produce a dorsal dislocation of the phalanx, may cause fracture of the sesamoid. This corresponds to the direct type of fracture as occurring in the case of the patella. The main feature of such a case is the overextension of the muscles, tendons and sesamoid structures against the metatarsal head or compression between it and the traumatic agent.

In this case there was conclusive evidence of direct injury, elsewhere in the foot, since the metatarsal heads were fractured. Naturally it is more difficult, in the case of the foot, to say which mechanism is directly responsible for the fracture, and this renders the discrimination between direct and indirect fractures very indefinite.

Speed summarizes the causes of fractures of the sesamoids of the hallux as follows: (1) Direct violence due to the fall of heavy objects on the foot; (2) squeezing the hallux between heavy masses; (3) falls from a height on to the foot; (4) sudden increase in weight-bearing force when carrying heavy weights.

In fact, it will be noticed that the fractures of the sesamoids of the hallux usually occur in such circumstances as the following: Jumping on the feet; stepping off stairs and causing extreme toe hyperextension; a fall from a

height; hitting the foot against a rock while swimming; as dancing and skating accidents; catching the foot in a hole; falls of heavy objects on the foot, etc.

The great majority of the above mechanisms are of the direct type of violence. The indirect type of fracture arises only when the toe is caught by the trauma, which produces a sudden marked hyperextension of the phalanx and followed by a tightening up of the adjacent tendinous structures. The reason why the fibular sesamoid of the hallux is so seldom injured appears to depend on the facility with which it escapes into the interval between the metatarsal heads, on following abduction of the toe, and thus avoids impact against the hard substance of the metatarsal extremity. This I have shown and discussed in the anatomical section of this article. The same reasoning does not apply in the case of the tibial sesamoid of the hallux. Moreover, the frequency with which this bone appears to be normally divided, renders the possibility of mistake greater than is supposed by some authors. These points were brought forward in the anatomical part of this paper.

Putti, Stumme and others have stated that the history of the case, the X-ray examination of the opposite foot, and the line of the supposed division are matters to be studied before a diagnosis of fracture should be given.

The fragments in congenital cases usually show a transverse line of division, which in some rarer cases is oblique or even longitudinal, and the lesion is not uncommonly present in both feet. These facts have been well illustrated in the first part of this article published in the *Journal of Anatomy*. On the other hand, the unilaterality and the irregularity of the line or lines of division cannot be held to exclude the possibility of congenital division—Momburg, Scott and others have insisted on this.

The appearance of tooth-like projections in the line of division is a character to be looked for in the case of larger bones, and practically cannot be recognized in the case of the sesamoids. It appears that the *degree of separation of the fragments, the unilaterality and the irregularity of the line of division,* when they are all present, are the most important guides in the diagnosis of fracture. In fact, I venture to suggest that some of the cases given in the above list were not real fractures, for the reason that some did not show sufficiently marked separation of the fragments.

On the other hand, too much stress should not be laid on *pain* in the diagnosis of fracture. In fact, it is difficult to see how a mere transverse division of a tibial sesamoid, without any separation of the fragments, should cause much pain. Momburg expressed the opinion that pain is due to the trauma producing dislocation of the fragments and to a secondary inflammation in the joint. Igelstein, on the other hand, thinks that pain follows pressure on nerves by the fragments. The cause of pain in congenital cases of division is very difficult to explain, and it probably has an origin similar so that of tenderness in cases of Morton's metatarsalgia, which has been, by Sir Robert Jones, explained as due to " treading upon the nerves."

In some individuals the pain appears to be associated with a cause which has been overlooked: tendency to weakness of the foot, spurs, etc. In Case III it was possible to find a fracture of the tibial metatarso-phalangeal sesamoid of the hallux associated with a metatarsal spur. It is said that in some cases the pain has been relieved by the removal of the sesamoid.

Serafini states, in a special chapter of his paper on inflammatory lesions of the sesamoids, that when neither fracture nor luxation of these bones is seen, the metatarsalgia is possibly due to periostitis of the sesamoid, the periostitis being the result of frequent and repeated trauma, wearing tight boots, etc.

In some cases the injury to the sesamoid is associated with an injury to the neighboring bones, and this has been considered by some authors to be the best proof of the fracture being of the direct type.

The two metatarso-phalangeal sesamoids of the hallux are very seldom fractured in the same foot. Painter's case is unique, as both sesamoids were fractured transversely. The injury occurred in a man sixty-six years old, who injured his foot while walking over the rocks.

Clinically in fracture of the sesamoids alone, without any apparent injury to the neighboring structure, there is a history of trauma, followed by some local swelling, pain and tenderness on walking, pressing the metatarsal head, or moving the toe. A few cases have been reported in which there was no trauma, and the diagnosis of fracture was made on the ground that the lesion was unilateral. It is to be remembered that congenital divisions are often unilateral; as cases of fracture in both feet may occur.

Swelling is only of diagnostic importance if it is well localized around the metatarsal head and appears to persist for some time after the injury.

The pain is in some cases spontaneous and has the same features as in any other fracture and is very marked when associated, as frequently happens, with fracture of the phalanges or metatarsals.

The tenderness can be elicited by pressing on the ball of the foot or making passive movements of abduction and adduction of the toe.

Crepitation has been felt in some rare cases.

The plantar X-ray examination of both feet is essential; and on the fractured side a lateral view should also be taken. This is more conveniently done with the foot placed in a slanting position of 90 degrees, in order to avoid the projection of the toes on the plate. This position shows very clearly, in some cases, the interval between the articular surfaces of the sesamoids and metatarsal head. The image of the sesamoids usually overlaps.

The *treatment* of fracture of the hallux sesamoids is divided into non-operative and operative. The majority of authors are of opinion that rest at first, plaster, and later massage are the best measures of treatment. I found that a *metatarsal bar* in the sole of the boot, as recommended by Sir Robert Jones, is an essential item in the treatment of these cases. Any associated condition should be carefully dealt with.

Operative treatment consisting in removal of the fractured bone is advo-

cated by some, when troublesome symptoms persist for some time after the injury; or, immediately after the trauma as a prophylactic measure. Some surgeons have even removed congenitally divided sesamoids for localized pain over the metatarsal head.

Cases of *luxation* of the hallux sesamoids are occasionally referred to in the literature (Gillette).

> Sir W. Thorburn, in 1896, refers to a case of a man sixty-one years of age, a laborer, who suffered from pain in the foot, after the fall of a heavy weight. He removed the lump which was followed by the relief of the pain. Little denied that the pain in this case was due to the apparent luxation of the sesamoid, which he always found to be present in hallux valgus. The big toe appears, in the X-ray positive, to be abducted as Little maintained.

Perlmann, in 1904, describes a luxation of the proximal phalanx of the hallux, fracture of the head of the second metatarsal and luxation of the tibial sesamoid to the outer side of the metatarsal head. This case has several points of resemblance with my Case I, and shows a rare occurrence of luxation of the tibial sesamoid of the hallux. This case did well with massage and rest.

Karschulin, in 1906, reports a case of luxation of the metacarpo-phalangeal articulation and of the sesamoids of the hallux.

On the other hand, Hancock, 1873, refers to resection of the hallux sesamoids by Hilton on two occasions. He adds, that ankylosis was obtained in the diseased joints. Sir R. Jones has had one case " in which a portion of the metatarsal head of the hallux had been fractured and was ankylosed to a crushed sesamoid."

Sesamoidectomy for the treatment of hallux valgus has been mentioned by Twinch on a discussion following the reading of Freiberg's paper on injury of the hallux sesamoids.

Occasionally the supernumerary bones of the foot may be the underlying cause of swelling and pain after a trauma, or, more rarely without any traumatic history. Elmslie, Painter, Malone and others refer to cases in which the os tibiale externum was the apparent cause of some disability which disappeared after its removal. The same has been reported (Stropeni, etc.) of almost every supernumerary bone of the tarsal range. In the anatomical part of this paper I have referred to several cases of supernumerary tarsal bones in which there were no symptoms, including a very advanced case of trochlear process of the talus, being the case able to wear boots and comfortably walk long distances. I referred already to a case of fracture of the os trigonum due to bullet. It is well to bear in mind, as I have pointed out, that these bones frequently have multiple centres of ossification.

Fracture of the hand sesamoids has been mainly seen in the metacarpo-phalangeal sesamoids of the pollex.

> Parker, in 1901, reported the case of a woman who suffered from pain at the inner side of the head of the first metacarpal. The case was not X-rayed. Parker suggested that it was a case of sesamoid disability.

Preiser, in 1907, mentions a fracture of both sesamoids of the pollex in a woman.

Morian, in 1909, describes a case of fracture of the ulnar sesamoid of a man, and shows different experimental varieties of fracture of the sesamoids of the pollex.

Maas, in 1912, refers to another case of fracture of the ulnar sesamoid of the pollex in a man. Skillern, in 1915, reports a similar case and repeats the experimental work of Preiser and Morian on the cadaver obtaining different types of fracture of the pollex sesamoids.

Evans, in 1919, reports the case of a transverse fracture of the ulnar sesamoid of the pollex.

In 1913 I was fortunate enough to meet with and reduce by an operation a dislocation of the phalanx of the pollex over the metacarpal head. The dislocation followed a violent blow with a stick, producing hyperextension of the thumb, in a man aged forty. The skiagram revealed a fracture of the radial sesamoid of the pollex metacarpo-phalangeal articulation.

Contrary to what has been said in reference to the hallux, the sesamoids of the pollex often appear both fractured. In rare cases of experimental fracture, as Preiser pointed out, the sesamoid appears to be the seat of marked comminution. The transverse division is, however, the commonest direction of the fracture.

A direct injury appears to be responsible for the multiplicity of the fragments produced, whereas a transverse or slightly oblique fracture seems to be the result of the so-called indirect injury. A hand caught by a closing door; the impact of a falling body on the hand; falling on the hand; the dislocation of the primi-phalanx producing marked hyperextension of the pollex, such are some of the histories given, as indicating the mechanism of the fracture of the pollex sesamoids.

Pain, tenderness, and swelling, localized to the metacarpal head, are the main features of the clinical picture.

The trigger-finger is another injury of clinical importance, which is possibly associated with sesamoid structures. Poirier, in 1889, suggested that the lateral ligaments of the metacarpo and interphalangeal joints were at fault. This theory met with much criticism, and Adams remarked that Poirier's idea might apply to the hammer-finger only.

Marchesi and Weir's papers and a study of the recorded cases lead me to suppose that the fibrous sesamoids of the interphalangeal joints are responsible in some cases for this curious disability. There is no reason why the tendinous thickening felt in the palm of the hand should not be a secondary sequela. It certainly improves in some cases after a course of physiotherapeutics only, as I have verified in two cases of my own.

If this conception of the cause of the trigger-finger, in its earlier stages, is accepted, one may regard the snap-finger as a condition allied to the locking of a knee cartilage.

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TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

Stated Meeting Held May 2, 1921

TRANSPLANTATION OF UTERINE FIBROID TO THE OMENTUM WITH FORMATION OF A LYMPHANGIOMA OF THE OMENTUM

Drs. John H. Girvin and John Speese reported the history of a woman, thirty-nine years of age, who had noticed a lump in her abdomen for nearly three years, and within the past three months had had two severe and several slight attacks of abdominal pain which were supposed to be caused by a twisting of the pedicle of the intraabdominal mass. She was operated on at the Presbyterian Hospital on February 1, 1921, by Doctor Girvin.

Upon opening the abdomen, the omentum presented and was somewhat thickened and almost rigid. This was due to some engorgement of the vessels, especially on the right side where one was almost as large as one's little finger. The vessel was surrounded by a series of lymphatic cysts; those at the lower end as large as a small egg and grading down to the size of a large pea at the border of the stomach. These were under high tension and so closely arranged that they gave the stiff feeling to the omentum. At its lower edge, the omentum was attached to a pedunculated subserous fibroid growing from the left side of the fundus uteri. The tumor about the size of a grape fruit (Fig. 1) had a pedicle about one inch long that had become twisted nearly three times so that the circulation was practically cut off and it was entirely nourished by the omental attachment. The omentum was detached and ligated by three ligatures and the largest cysts punctured. The tension was so great that the fluid spurted five or six feet.

The omentum was wrapped in pads and replaced in the abdomen and a supravaginal hysterectomy performed, with the removal of both tubes and ovaries, which were distinctly cystic. The body of the uterus was irregular, enlarged but rather soft. At the conclusion of the hysterectomy the omentum was examined, and, as the majority of the cysts were collapsed, it was replaced and the abdomen closed without drainage. She left the hospital in good condition on February 27th. She has had no abdominal symptoms since and her physician reports her now in very good condition.

One of the cysts removed for study shows, on microscopic examination, the wall to consist of the characteristics of omental tissue, in which numerous thin-walled vessels appear. These are uniformly lined with a layer of flat endothelial cells. Many of the vessels are collapsed, others are distended and contain homogeneous material, characteristic of lymph. The picture corresponds to that usually seen in lymphangiomatous formations.

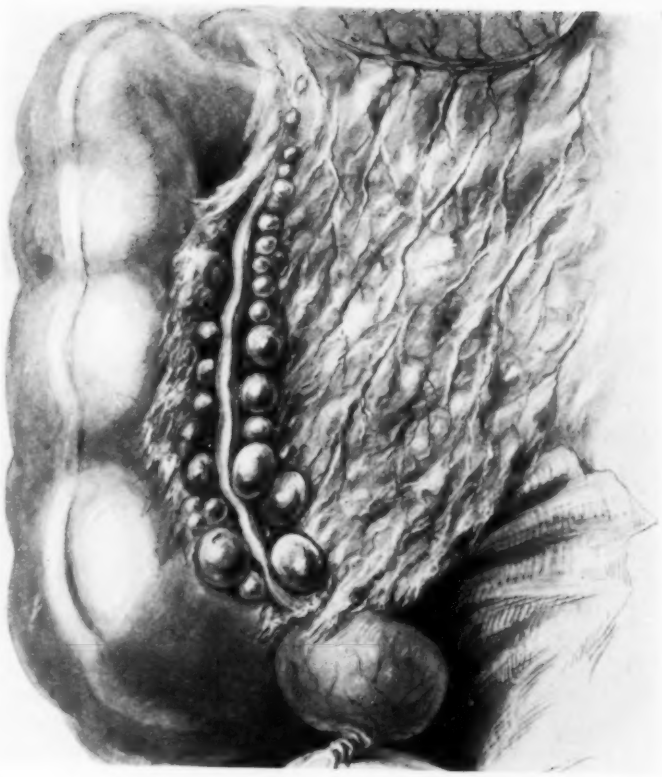

FIG. 1.—Lymphangiomatous cysts of the omentum.

FIG. 2.—Outerbridge's case of cyst omentum

The reporter said the subject of cystic lymphangioma of the great omentum was brought to the attention of the Academy in 1914 by Outerbridge, who then thoroughly reviewed the etiology of the condition. At this time about fifty cases of this comparatively rare disease were recorded in the literature. The case now described bears a striking resemblance to the one recorded by Outerbridge, the omentum being adherent to the uterine fibroid, the cystic tumors appearing in the free margin of the omentum and in close association with the omental blood-vessels.

If it is assumed that in the omentum the chief lymph channels follow the larger blood-vessels, Outerbridge believes by this anatomical condition can be explained the production of the more or less continuous chain of cystic structures around the entire edge of the great omentum. Any factor leading to obstruction of the lymphatics, inflammation, adhesions, etc., may cause cystic dilatation, and through proliferation of the endothelium give rise to true lymphangiomatous formation.

Jacobi states that all true omental cysts are lymphatic in origin. According to Stillman, it is significant that the swelling of the abdomen was first noticed at some period between the ages of one and ten in fifteen of twenty-one cases operated upon, and in ten of these, or nearly half of the cases he collected, the swelling was noticed between one and four years of age. While such facts point to the congenital nature of the cysts, and the possibility of a congenital origin from embryonic rests or from the surface peritoneum cannot be denied in certain cases, in the majority, however, it must be admitted, as proven, that the origin of such growths is to be found in the lymph-spaces.

Of the total of forty-six cases of omental cyst formation of all kinds, Stillman found but twenty-two to be true serous cysts; of these nine occurred between one to four years of age, six between five to eleven, the others at the ages of seventeen, nineteen, twenty-two, thirty and forty-two. Sixteen occurred in females and six in males.

The majority of the cases are discovered by accident in the course of operation for other abdominal conditions. In certain instances the large size of the cyst has brought about symptoms suggestive of ovarian cyst or ascites. In certain of the larger cysts complications develop which make surgical intervention necessary. Among these conditions are twisting of the pedicle with symptoms of appendicitis as reported in a boy of four by Speese; suppuration and gangrene of omental cysts have also been reported.

The operation consists in removal of single cysts, or as much of the omentum as may be necessary when this structure is involved by multiple cysts. In the case reported complete extirpation of the cyst-bearing area of omentum, as recommended by some authors, was not undertaken because it was thought that with removal of the adhesions and detachment of the omentum from the uterus, obstruction of the lymphatic channels may have been sufficiently overcome to permit a return to a normal state of the omental

lymphatics. So far there has been nothing in the post-operative history of the patient to suggest that such has not been the case.

Doctor Outerbridge referred to a case which he had presented before this Academy seven years ago, which very closely resembled the case of Doctor Girvin's. The case was a colored woman of thirty-four or thirty-five years of age, who had a fibroid tumor. She was operated on by Doctor Beyea. When the abdomen was opened a large mass which resembled grapes presented in the wound; on further examination this proved to be the omentum, around the entire edge of which were grapelike masses, ranging in size from that of a Malaga grape down to a pinhead, with a string of small ones running down through the centre of the omentum. These masses were filled with a clear fluid. The whole omentum along its free border was attached firmly to the upper surface of the subserous, pedunculated fibroid tumor growing from the fundus of the uterus. There were very extensive evidences of inflammation throughout the pelvis, the tubes and ovaries being bound down by adhesions to the tumor. In this case Doctor Beyea did a complete hysterectomy and also resected the omentum up to the transverse colon, ligating just below its attachments, so that we had the entire specimen for pathological study.

A careful microscopical study was made of a number of the cysts of varying sizes. In all instances the picture was practically identical—a fibrous wall containing more or less intense round-cell infiltration, lined on the side of the cyst cavity by a single layer of flat cells, similar to those seen lining the peritoneal cavity. In the substance of the walls of many of the larger cysts were seen numerous irregular spaces of varying sizes, lined by similar cells, and containing a small amount of homogeneous material, taking a pinkish stain in hæmatoxylin-eosin preparations. These represented, obviously, dilated lymphatic spaces. Owing to the unbroken transition between these and the smaller cysts, and from them to the largest cysts, and also owing to the position of the cysts along the course of the larger blood-vessels with their accompanying perivascular lymph-spaces, he came to the conclusion that the specimen represented a lymphangioma, originating from the perivascular lymph channels, and due probably to the interference with the lymph current resulting from the extensive adhesions.

In medical literature a number of very similar cases have been reported, arising in conjunction with omental adhesions to fibroid tumors.

CHONDROFIBROMA OF THE FIBULA

Dr. Robert G. Le Conte reported the history of a woman, twenty-one years of age, who sought advice of Doctor Le Conte in November, 1919, for a swelling below and to the outer side of the left knee. She could not remember when this first appeared, but stated that it had been present for some years. Neither could she recall any injury to this region. The tumor caused no pain and practically no disability. The examination showed a large, firm, painless, non-inflammatory swelling over the upper part of the left fibula. The general examination was negative. The X-ray showed a tumor, apparently cystic, arising abruptly from the upper end of the fibula,

which possessed a clear-cut bony capsule within which were several spicules of bone. The tumor, together with the head and upper third of the shaft of the fibula, were resected. The muscles were adherent over the tumor and there was slight attachment to the external lateral half of the tibia, corresponding to the shadow shown in the X-ray picture. The peroneal nerve was held in a groove in the tumor, and was separated with difficulty. After removal the bony capsule was found to be 5 mm. thick, and the contents white and shiny, cutting like cartilage. The cortex of the fibula was very thin at the point of attachment. The wound was closed without drainage and primary union resulted. A diagnosis of sarcoma was made at the time of the operation. A histological diagnosis of myxofibroma was made by the laboratory. The recovery was uneventful but a definite degree of toe-drop resulted. Recent physical examination, March, 1921, shows that the toe-drop has definitely improved and there is elevation of the foot to about two-thirds of the normal motion and the patient states that she is able to do rhythmic dancing. The X-ray taken at this time showed definite recurrence of bony tissue in the soft tissues of this area and an enlargement and increase in the density of the shadow first noted in the tibia before the operation. Doctor Bloodgood, who saw the patient in consultation, considered these shadows an evidnce of ossification at site of operation, and not a recurrence of the tumor.

A final histological study of the specimen, which has been confirmed by Dr. Allan J. Smith, shows the body of the tumor composed of a relatively small number of spindle-shaped fibrous-tissue nuclei, approximately normal in appearance, but haphazard in arrangement, and a much larger proportion of fibroglia fibrils. Small masses of cartilage are present throughout. A moderate number of small, thin-walled vessels can be seen. This structure is enclosed in a capsule composed of small bony fragments, separated by a fibrous structure. This connective tissue is like that within the tumor, except that it has an orderly arrangement about the bony spicules and contains a few giant cells with from six to twelve nuclei. This fibrous process penetrates entirely through the bony capsule and comes in contact with muscle tissue. The body of the tumor is doubtless neoplastic, while the capsule suggests a chronic fibrous osteoperiostitis. There is nothing, however, to suggest a malignant process. Diagnosis: Chondrofibroma of the fibula.

Doctor Le Conte added that these cases are of interest in the light of the studies by Platou, Barrie, Coley and Bloodgood on ostitis fibrosa cystica and giant-cell tumors of the long bones. The purpose of these studies has been to place in the benign category certain osseous tumors formerly considered malignant, namely the so-called giant-cell sarcomas of the epulis type, and to establish a differential diagnosis between them and the malignant form of giant-cell sarcomas. These authors show that there is a close relationship between ostitis fibrosa cystica and giant-cell tumors, and suggest the possibility of their constituting a single progressive process. Barrie further suggests that they be considered as chronic inflammatory processes rather than neo-

plastic lesions; and advocates their treatment by conservative means. Bloodgood has reported thirty-five cases diagnosed bone cyst, or ostitis fibrosa cystica, and eighteen with the diagnosis of giant-cell sarcoma. The great majority of these were treated by curetting the cavities and swabbing them with carbolic acid and then alcohol. A few were treated by amputation. They were followed over a period of years, the longest fourteen, and in none did metastasis occur. A few developed local recurrence, which was cured by a second curettage or by amputation. Further evidence of the benign nature of the tumors of the long bones is furnished by Bloodgood, who reports that he has successfully curetted or resected several which had broken through or destroyed their capsule. All these authors, however, emphasize the difficulty of differentiating the benign from the malignant type in every case and agree that at present it cannot be done. Those cases from the Pennsylvania Hospital are placed on record for the purpose of aiding the study.

OSTITIS FIBROSA CYSTICA OF THE FEMUR

Dr. Waler Estell Lee and Dr. W. P. Belk presented a man aged twenty-two years, who in October, 1918, while on duty at League Island Naval Station had a mild attack of influenza and following this he first suffered with pain in the middle third of his right thigh. After about a month's convalescence, and while running across the parade ground, he fell and fractured his right femur at the point where he had previously felt the pain. An X-ray examination of the fracture disclosed a bone cyst, and at the operation performed at the Naval Hospital necrotic and diseased bone was removed. The pathological diagnosis of this tissue was ostitis fibrosa cystica. Unfortunately they had been unable to obtain sections of this tissue from the hospital. The wound healed by primary intention and the patient was later seen by D. J. Chalmers DaCosta, and he recommended his discharge from the service with a diagnosis of bone cyst of the femur and a disability of 80 per cent.

He entered the Pennsylvania Hospital in March, 1920, where he was referred by the Public Health Service. The examination showed a well-nourished young man walking with a limp. A large scar was found over the outer surface of the right thigh and there was a thickening of the middle third of the right femur and some tenderness. This extremity was one inch shorter than the left. No muscular or cutaneous involvement was found. The X-ray report of Doctor Bowen described a cystic appearance of the femur beginning two inches below the trochanter and extending downward for ten inches. The possibility of sarcoma was suggested. There was hypertrophy and bowing of the bone at the seat of the fracture, which was well healed. At operation a long incision was made on the external surface of the thigh extending from the greater trochanter to the external condyle, exposing the femur for this distance. The medullary cavity of the bone was opened by chiseling a trough from the greater trochanter to the condyle. The bone was found to be very thin and in places barely of the thickness of

an egg shell. There were three distinct cavities more or less separated by fibrous septa. In these cavities a jelly-like substance about the color and consistency of currant jelly was found. The entire medullary cavity was then curetted, which were followed by very free bleeding. Carbolic acid was then applied to the walls of the cavity and finally this was neutralized with alcohol. The wound was closed without drainage. Primary union resulted and the recovery was uneventful. He was discharged from the Pennsylvania Hospital four months later and referred to Dr. William B. Coley at the Memorial Hospital, New York, where radium and Coley's fluid were given. A letter received from Doctor Coley states that recent X-ray and physical examination have failed to show any signs of recurrence. Coley's fluid has been now discontinued because of severe reactions and an alarming loss of body weight.

The histological study confirmed by Professor Allan J. Smith of the material removed at the second operation shows small fragments of bone and blood which crepitate and break up like egg shell. Histologically small, irregular islands of bone are surrounded by loose, cellular and fibrous tissues, which in places look much like normal bone-marrow. Elsewhere there is much fibrous tissue which in places is rather cellular but has the appearance of chronic inflammatory process. A few giant-cells containing from six to eight nuclei are seen near the bone fragments. Considerable blood is present, but this could have easily been caused by the trauma of the curette. Blood-vessels are numerous, but their coats are well formed. The picture nowhere suggests a malignant process but rather a chronic fibrous osteomyelitis. Final diagnosis: Ostitis fibrosa cystica.

THROMBOSIS OF THE SUPERIOR MESENTERIC ARTERY

Dr. Leo B. Reed reported the history of a woman, aged fifty, who was admitted to the Polyclinic Hospital at 3.15 A.M., April 10, 1921, on the service of Dr. George P. Muller, suffering with intense, acute and paroxysmal abdominal pain. The pain radiated from the right umbilical region to the lower abdomen—especially on the right side. One year ago she had a similar attack and a second one, one month ago, both attacks however affecting her left side and lower left abdomen. Neither of these attacks was so intensely severe as the one which brought her to the hospital.

When admitted she had been suffering severe pain for three hours; she was in collapse with subnormal temperature, increased pulse-rate and respiration. Temperature, 96.4°; pulse, 100; respiration, 32. Skin was cold and clammy. She was nauseated and vomited frequently. Complained of pain in the right and lower abdomen which was paroxysmal and progressively increased in intensity.

The abdomen was flaccid on admission but half hour later had become boardlike; most marked in the right iliac fossa. Generalized abdominal tenderness, also most marked in the right iliac fossa but not increased by deep palpation. Abdomen was tympanitic throughout and peristalsis normal but

not visible. No history of blood in her stools or painful defecation or tenesmus. Slight grade of constipation.

Laparotomy was immediately performed by Doctor Ravdin under ether anæsthesia.

The lower ileum was found collapsed with slight injection of the blood-vessels. The upper ileum and jejunum were distended and bluish in color, the picture resembling an intestinal obstruction. Upon removing the intestines from the abdominal cavity there were found one large thrombus about two inches in diameter and several smaller ones, all in the mesentery of the small intestine, therefore involving the superior mesenteric artery. There was no involvement of the mesentery of the large intestine. No evidences of any effects from lack of blood supply could be detected except the bluish discoloration of the jejunum and upper ileum. In the ileum, opposite the largest thrombus, was a definite constriction. Above this point there was distention and below collapse of the intestine. Appendix was found to be very greatly elongated and obliterated but not congested. It was removed. No free fluid was found in the peritoneal cavity.

The abdomen was closed by the usual method without drainage. The patient was put in the semi-Fowler position with continuous enteroclysis of 5 per cent. solutions of sodium bicarbonate and glucose for forty-eight hours. Patient's condition to date is very favorable.

Doctor Reed remarked that this is a mesenteric thrombosis of moderate grade which was not diagnosed previous to operation. A review of the literature shows that the following symptoms should always call to mind this condition: (1) Age—most common between ages of twenty to sixty. (2) Abdominal pain—sudden, severe and colicky. May be paroxysmal or continuous. (3) Tenderness—extreme throughout whole abdomen. (4) Abdominal distention is a constant sign and increases as the disease advances. It is usually quite general, but there may be an occasional area of dullness due to œdema of the intestine which is common and early. This may per se largely contribute to intestinal obstruction. Accumulation of fluid in the flanks may give dullness. (5) Palpable tumor, due to the formation of a hæmatoma between the layers of mesentery. This may be hard to find on account of the extreme tenderness and rigidity. (6) Rapid and excessive fall of temperature with weak and rapid pulse. (7) Diarrhœa—due to irritation. (8) Results of acute intestinal obstruction: (*a*) Painful defecation; (*b*) obstinate constipation; (*c*) vomiting and nausea. (9) History of an injury or some previous condition which might cause embolism.

Dr. John H. Jopson said that three cases of mesenteric thrombosis had been admitted to the Presbyterian Hospital during the past winter. One of these cases was admitted to the medical service in a moribund state and died in a few hours. Mesenteric thrombosis was found at the post-mortem examination. Two cases were under his care on the surgical service. In one case the condition occurred in a young married woman, twenty-eight years of age. She was admitted to the hospital suffering with what was diagnosed

as an attack of pelvic peritonitis, of very acute onset. Appendectomy had been performed fifteen years previously. Causation of the condition was not to be explained. On opening the abdomen there was found a cavity in the pelvis filled with blood, mixed with a small amount of pus, and not connected with the uterus or adnexa. Its walls were formed by adherent loops of bowel, which in places exhibited patches of gangrene. The cavity was drained, and a few days later the patient developed a complete fecal fistula, and following this improved markedly and rapidly. About six inches of intestine were discharged from the wound as a necrotic mass and the intestines were moved entirely through the wound. One month after the first operation the abdomen was reopened and it was found that the last portion of the ileum had sloughed just above the ileo-cæcal valve, and the remaining ends were lying open at this point, and resembling the double-barrel appearance of a two-stage enterectomy. Anastomosis of the terminal ileum with the ascending colon was followed by recovery.

The remaining case was the most interesting. If it had not been for the influence of Dr. George G. Ross's paper, read before the 1920 meeting of the American Surgical Association, the result would probably have been less fortunate, as he would have felt impelled to do a very radical operation. The patient, a negro cook, about fifty years of age, was admitted with a diagnosis of appendicitis, made by an outside physician, and of acute onset, and about four hours' standing. Morphia had been administered, and immediate operation urged. Before operation there seemed no reason to interpret the history or physical signs differently, the local symptoms being characteristic. The patient showed however a low temperature and seemed somewhat shocked. Operation six hours after onset of pain. The abdomen was found well filled with blood. The appendix was normal. The last four feet of the ileum were swollen, congested, the site in the mesentery, of a thrombosis extending well toward the base of the same. The hemorrhage had occurred from the serous surface of the gut. The latter looked still viable. We recalled that in a similar case of Dr. John B. Deaver's, reported in Ross's series, he had closed the abdomen in the face of similar findings, and that the patient recovered. Also that this was the only operated case which did recover. We therefore wiped out some of the blood and closed the abdomen. The post-operative course was marked by an incomplete intestinal obstruction which yielded to treatment, including repeated gastric lavage. This patient also recovered. In reply to a question concerning the occurrence of intraintestinal hemorrhage, he recalled that the last case had tarry stools, the other two he thought had not this symptom.

Doctor Despard said that he had recently had a case of mesentery thrombosis in a young woman twenty-five years of age, which seemed to be associated with an attack of influenza accompanied with sore throat, followed by diarrhœa which lasted for several days before distinct abdominal symptoms of a serious nature made their appearance. With the decrease in the number of bowel movements, violent peristaltic pains commenced and persisted for

twenty-four hours, at the end of which time she passed a small amount of clotted blood. During the next eighteen hours there were six movements of liquid blood. When admitted to the Methodist Hospital the symptoms were those of obstruction with peritonitis. Upon opening the abdomen he found extensive gangrene of a part of the ascending and the entire transverse colon, as well as a large part of the omentum.

Resection seemed the only possible procedure, which was done as expeditiously as possible. The patient stood the operation well and the following day was comfortable and sanguine of her own recovery. While there were no further abdominal symptoms, her pulse became progressively more rapid and weak, and she died on the second day after the operation, apparently overwhelmed by toxins, as so many obstruction cases do.

MALIGNANT DEGENERATION OF BENIGN TUMORS OF THE THYROID GLAND

A paper with the above title was read by Dr. John Speese, for which see page 684.

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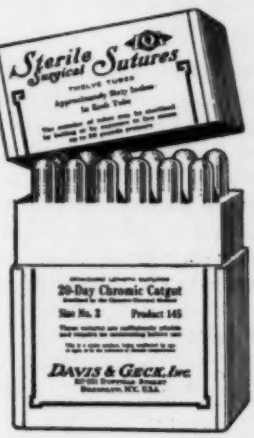

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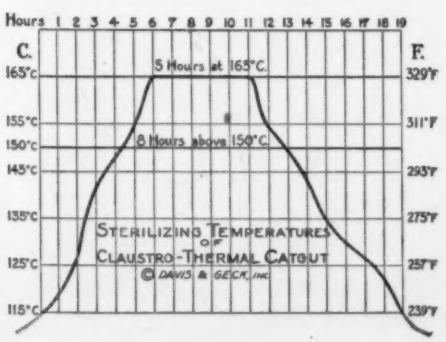

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892	Umbilical Tape	Two 12-Inch Ligatures	

Price in U. S. A.—Per dozen tubes (subject to a standard discount on quantities) $1.50

In packages of twelve tubes of a kind and size as illustrated on first page

Emergency Sutures

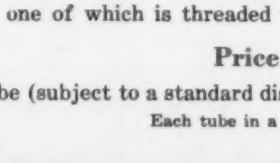
With Needles

Sterilized by Heat After Closure of the Tubes

Product No.		Approximate Quantity in Each Tube	Standardized Sizes
904	Plain Catgut	20 Inches	00, 0, 1, 2, 3
914	10-Day Chromic Catgut	20 Inches	00, 0, 1, 2, 3
924	20-Day Chromic Catgut	20 Inches	00, 0, 1, 2, 3
964	Horsehair	Two 28-Inch Sutures	00
974	Plain Silkworm Gut	Two 14-Inch Sutures	0
984	White Twisted Silk	20 Inches	000, 0, 2

Price in U. S. A.

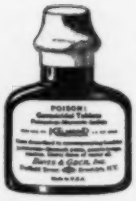
Per dozen tubes (subject to a standard discount on quantities) .. $3.00



In packages of twelve tubes of a kind and size as illustrated on first page

Potassium-Mercuric-Iodide Germicidal Tablets

Trade KALMERID Name



To Supersede
Bichloride of Mercury
Iodine
Carbolic Acid
and the
Cresol Preparations

For disinfection of suture tubes, skin, hands, utensils, excreta; irrigation and disinfection of infected wounds, fistulas, sinuses, and ulcers; irrigation of the mucous membranes of the upper respiratory and genito-urinary tract.

Kalmerid tablets are readily soluble in water, in 85 per cent. alcohol, and in 85 per cent. acetone. Equal to bichloride of mercury in germicidal potency, and more potent than other mercury or iodine salts. Less poisonous and less irritating than mercuric chloride or tincture of iodine. Strongly germicidal in the presence of blood, pus, or mucus, because, unlike bichloride, potassium-mercuric-iodide does not coagulate or precipitate proteins.

Reprints of original articles and pamphlet on uses sent upon request

Each tablet represents 0.5 gram (7½ grains) Potassium-Mercuric-Iodide

Price

Per bottle of 100 tablets $3

A standard discount is allowed on original packages of ten bottles

Obstetrical Sutures

Product No. 650

For the Immediate Repair of Perineal Lacerations

Each tube contains *two* 28-inch sutures of 40-day chromic catgut one of which is threaded upon a large full-curved needle

Price in U. S. A.

Per tube (subject to a standard discount on quantities) ..... $ .35

Each tube in a package as illustrated

"BRIDGING THE GAP"

A FORWARD STEP

For the sole purpose of establishing a closer relationship with the foreign language publications our Managing Editor has spent the last two months in visiting European medical centers to arrange for the more prompt and accurate abstracting of foreign medical literature.

Sub-offices are now maintained also in Naples, Madrid and Vienna, where the abstracts are being made in their native tongue by Italian, Spanish and German medical abstractors. The French articles are dealt with similarly in Paris.

Then, our previously trained staff makes over these abstracts into English, and they will reach New York as quickly as (sometimes before) the foreign medical journals get there. Thus, the gap between the date of an article and its appearance in abstract form in our monthly Survey will be bridged, and our subscribers will appreciate the efforts made in their interest.

THE AMERICAN INSTITUTE OF MEDICINE HAS OPENED A CONTINENTAL BUREAU IN PARIS (at 13 Boulevard Malesherbes) AND HAS ESTABLISHED THERE ONE OF THE ASSOCIATE EDITORS, WITH CAPABLE ASSISTANTS FROM THE NEW YORK STAFF. THE LIST OF FOREIGN PERIODICALS HAS BEEN REVISED AND THEIR NUMBER HAS BEEN INCREASED, UNDER CAREFUL CONSIDERATION, WITH A VIEW TO COVERING THE FOREIGN FIELD MORE THOROUGHLY.

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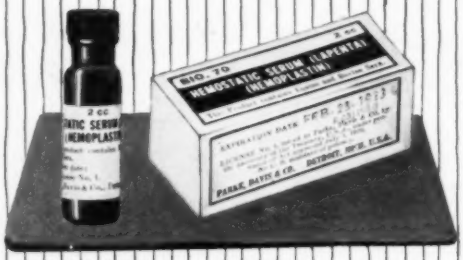

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HEMOSTATIC SERUM is a blood-serum derivative which contains substances essential in shortening the coagulation-time of the blood.

It is indicated in the treatment of hemorrhage of the new-born, purpura, hemoptysis, hematemesis, typhoid hemorrhage, etc.

It is indicated as a prophylactic against hemorrhages that usually attend certain surgical procedures, such as bone operations, tonsillectomy, amputations, and operations on the spleen and gall-bladder.

Hemostatic Serum is injected subcutaneously, intramuscularly or intravenously, the average dose being 2 cc. It is also applied locally to the site of the hemorrhage by means of a piece of sterile gauze.

Packages of 2-cc and 5-cc vials.

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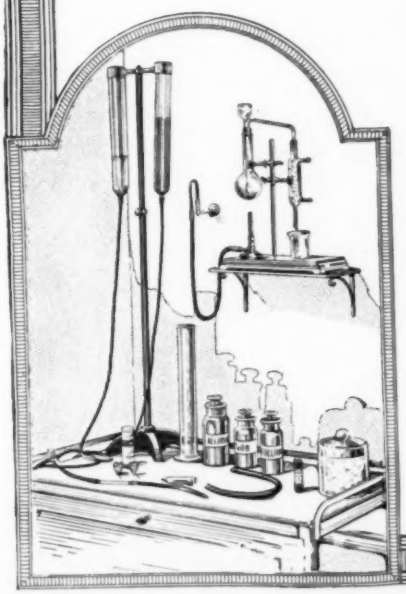
(SILVER-ARSPHENAMINE-METZ)

The sodium salt of silver-diamino-dihydroxy-arsenobenzene

Relative infrequency of reaction, rapid disappearance of contagious lesions, and general therapeutic effectiveness seem to indicate that Silver-Salvarsan is a drug of real value in the treatment of syphilis.

Silver-Salvarsan requires no alkalinization and its ease of administration commends it to many practitioners.

More than two million injections of Silver-Salvarsan have been given in the United States and abroad.



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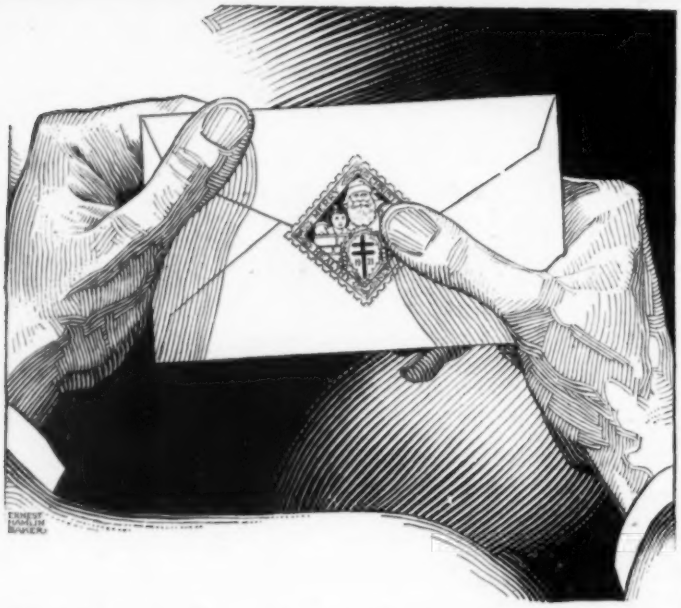


What the Christmas Seal Is Accomplishing

It is saving 75,000 lives a year.

It is providing hospital care for 100,000 tuberculosis patients a year.

Nearly 75,000 children are being restored to health in open air schools.

Over 5,000,000 calls a year are being made by 5,000 public health nurses.

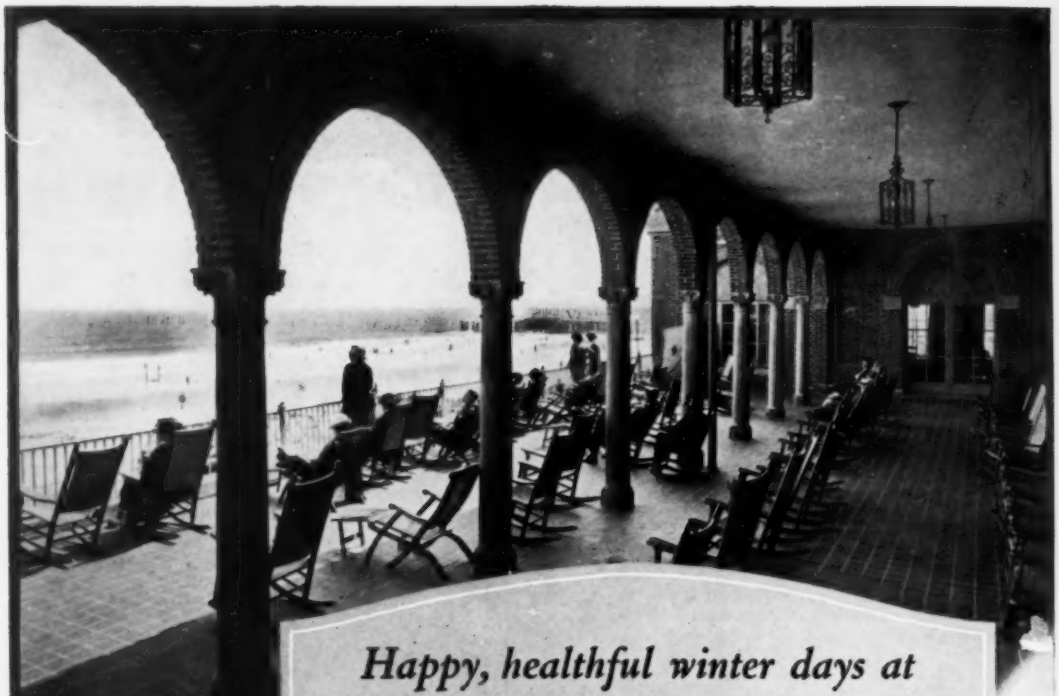
Practically all of our 110,000,000 Americans are being educated to better health.

About 7,000,000 school children are learning correct health habits through the Modern Health Crusade.

Help us keep up the good work by supporting this Fourteenth Annual Christmas Seal sale.

Christmas Seal your **Christmas Mail**

The National, State and Local Tuberculosis Associations of the United States



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